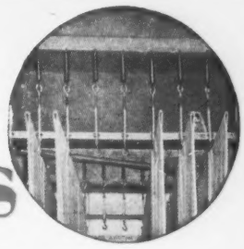
APR 30 1929

Rock Products

With which is Incorporated CEMENT and ENGINEERING NEWS Founded 1896

Chicago, April 27, 1929 (Issued Every Other Week) Volume XXXII, No. 9

NEW HAVEN FLAT BAG DUST ARRESTORS



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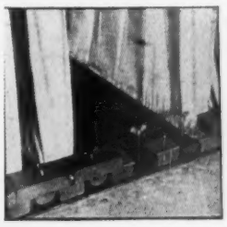

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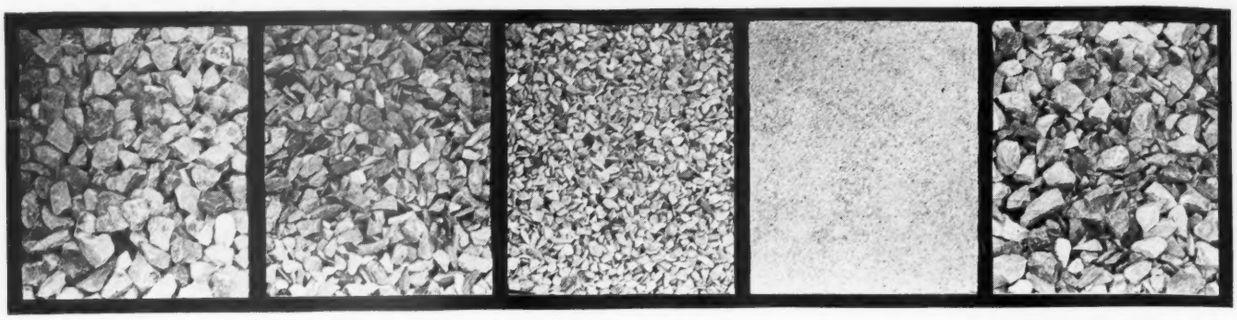

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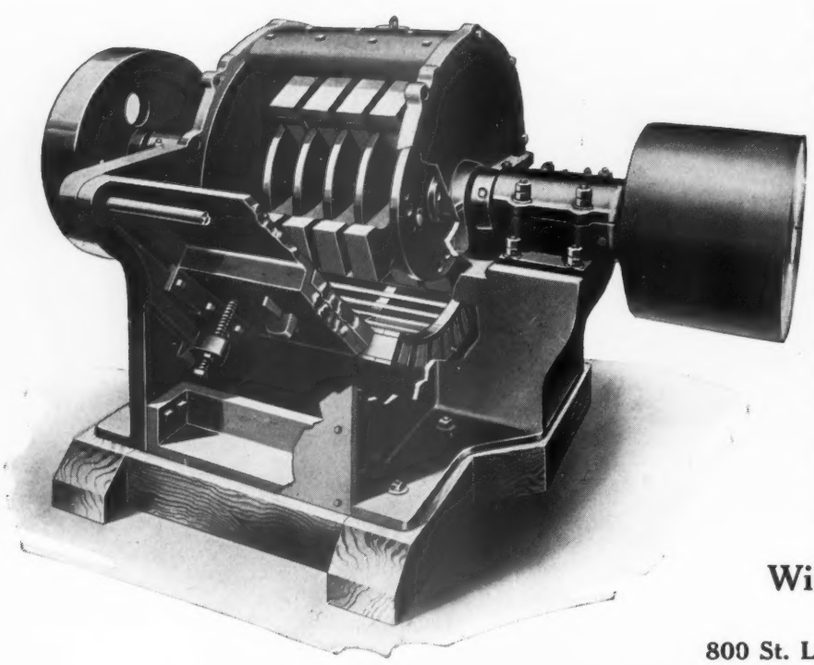

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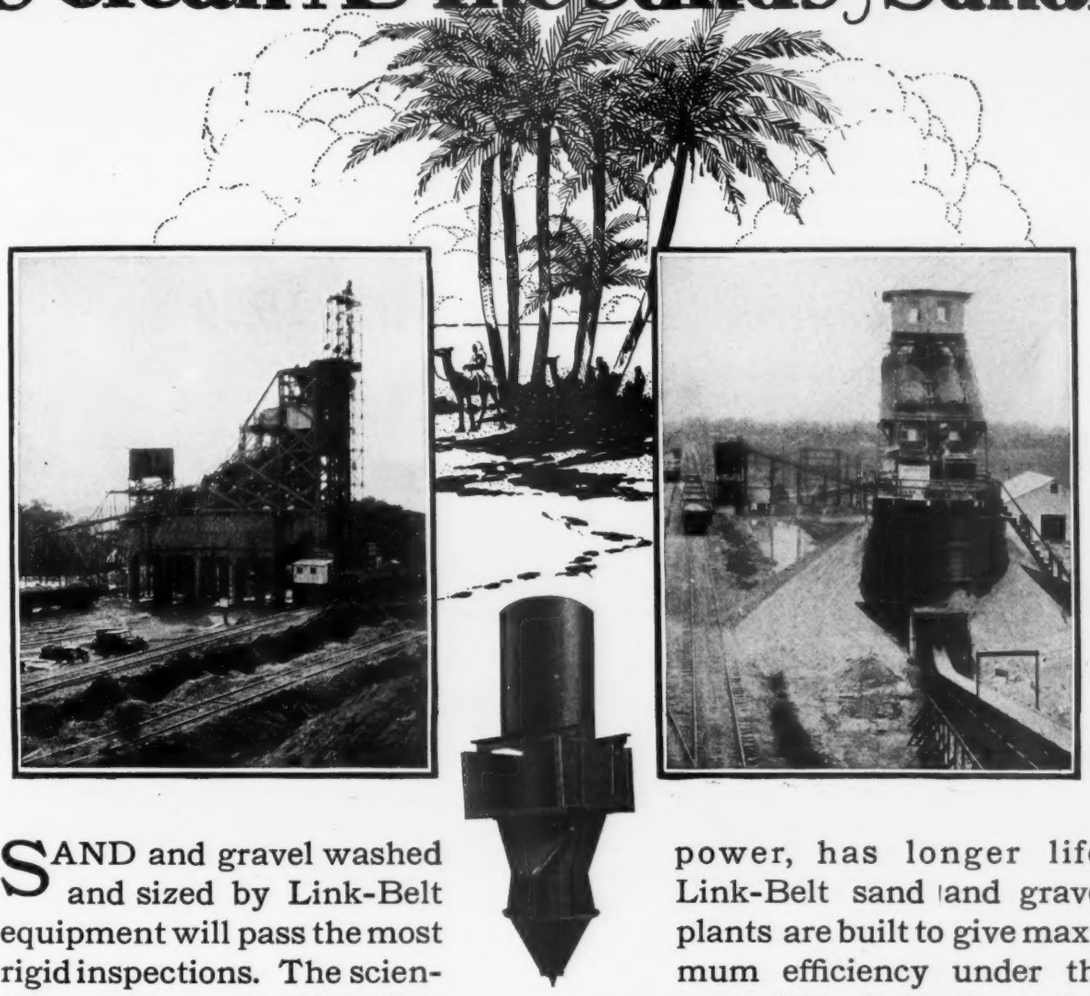

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LONDON OFFICE: Dorland House, Mezzanine Floor, 14 Regent St., S.W. 1.

NATHAN C. ROCKWOOD, *Editor and Manager*
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Volume XXXII Chicago, April 27, 1929 No. 9

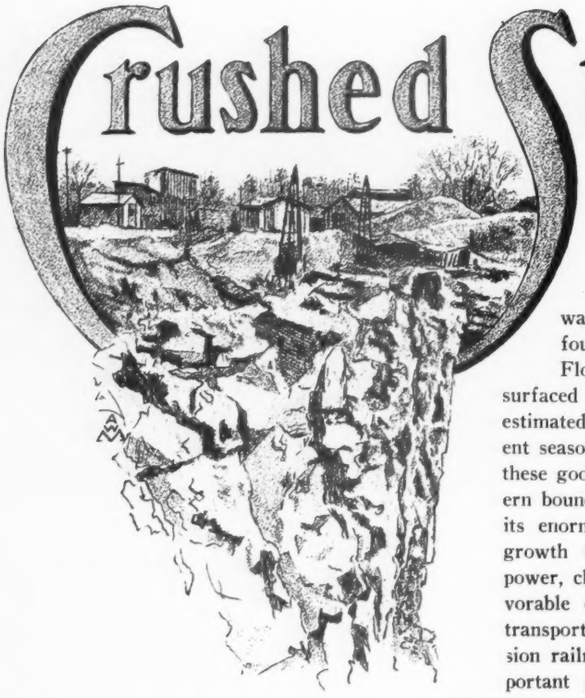
Rock Products

With which is Incorporated CEMENT and ENGINEERING NEWS Founded 1896

A new lime rock quarry being opened up by Southern Lime Products Co. near Cordele, Ga.

Crushed Stone Industry

By Walter

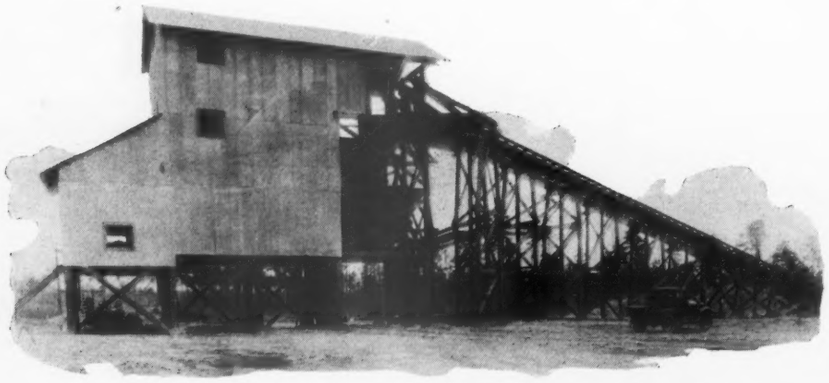


THE LARGEST MARKET for rock products materials in Georgia is that incidental to highway construction. Road building in that state has in the past been conducted by each county, and as there are upwards of 160 counties within the state borders, the result has been a large amount of money wasted, a considerable mileage of hard-surfaced highways of a disconnected and disjointed nature, and a system that has proven very expensive to maintain, so that what money is available, or has been available, has not provided the state with hard-surfaced arterial lanes of traffic of any appreciable and continuous lengths.

This year a $75,000,000 highway bond issue is before the legislature, the funds to be used to connect up the important system and to give that state a real connected and continuous hard-surfaced highway system.

Georgia and South Carolina are in a somewhat parallel position as regards their highway systems. On the southern foundry of the former state is Florida, with its miles of hard-surfaced roads (and its tourist income, estimated at $100,000,000 for the present season, which is a direct result of these good roads); and on the northern boundary is North Carolina, with its enormous industrial expansion, a growth that is attributed to cheap power, cheap and abundant labor, favorable climatic conditions and easy transportation. Under the last division railroads, of course, play an important part, as well as the state's geographical position with respect to the cotton-growing centers and the cotton-consuming markets, but North Carolina's hard-surfaced highway system has played and continues to play an important part in attracting industries to locate within its borders.

In between these two active states are South Carolina and Georgia, and both these states are now beginning to realize the disadvantages under which they are trying to progress. South Carolina is in a better position as regards industrial progress, yet in traveling northward one hardly needs to be told when the boundary line between South and North Carolina is passed.

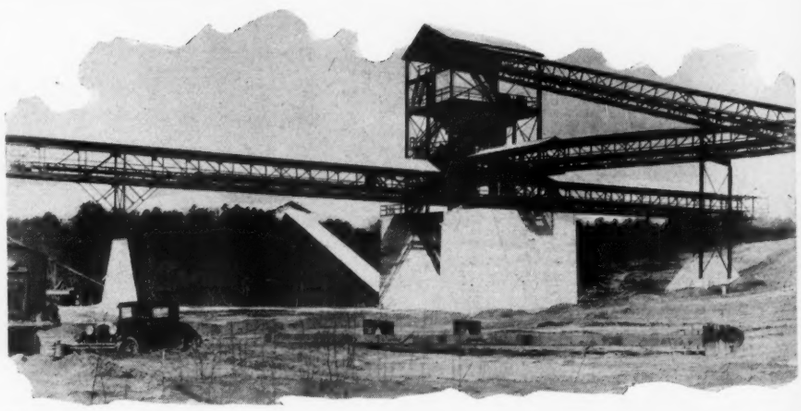


General view of the Southern Lime Products Co. plant

Prospects in Georgia

Bond issues for highway work are becoming each year more difficult to put across in most states, but there is hardly any question that the bill before the Georgia legislature will pass successfully, and that by this summer money will be available so that the plans of the state highway department can be carried forward. The unusual amount of rain in the South Atlantic states, especially in Georgia and South Carolina, tied up more or less practically all of the highways in the former state, and at the beginning of the flood period 39 highways were posted as impassable, some being washed out completely, bridges destroyed, and others simply impassable on account of mud. The rains have done enormous damage and caused unfortunate losses of life, but they have assisted the people of Georgia to realize the necessity of hard-surfaced highway construction as a prerequisite to any further industrial expansion.

In the south central part of the state of Georgia the rock products industry has been



Finish screening plant and storage building equipment of the Consolidated Quarries Co., Lithonia, Ga.

# of South Atlantic States

B. Lenhart

Opening up a new granite quarry near Atlanta, Ga., at the operation of the Consolidated Quarries Co.

seriously handicapped by the continuous rains, and production has been very low, but producers are optimistic as to the volume of business for the balance of the year 1929 and for the years to follow. One company, the Southern Lime Products Co. of Cordele, Ga., has faith in the immediate future of the business and has backed up its judgment to the extent of spending some $200,000 for a four-mile standard-gage railroad, including a 300-ft. trestle, and the construction of a crushing plant at Cordele. The four-mile spur will connect the plant with the Georgia Southwestern and Gulf railroad.

A Marketable Product Without Crushing

This plant is modeled somewhat after the plant of the Georgia Lime Rock Co., near Perry, Ga., which operates a quarry and plant at that location and has a capacity of 30 to 40 cars of crushed lime rock per day. The operation at the Cordele plant is also on a material similar to that at Perry, and as regards crushing methods, the flow of material is simplicity itself.

The material at Cordele is a high calcium limestone (93% $CaCO_3$) and is crushed to 3½ in., discharging direct to cars below, no sizing or grading being done; everything passing the roll crusher is a marketable product. The reason for this simplified operation is apparent when the nature of the stone and the use to which it is put are considered.

Limerock pit of the Southern Lime Products Co., Cordele, Ga.

The rock is referred to throughout Florida and Georgia as "limerock," not limestone, and is classified as the "Ocala limerock." It is a soft (one could almost say an earthy) material, and is used as a base material for a hard-surfaced road. It is similar to the limerock quarried near Ocala, Fla., in its property of forming quite a hard, dense conglomerate, when rolled or compacted, producing an excellent base material, and when protected from water with an asphalt top, makes a fairly satisfactory highway.

The operations of the Southern Lime Products Co. were just starting at the time of inspection, an area of approximately 100 ft. by 500 ft. having been stripped of overburden, which will average 4 to 5 ft. in thickness. The ground surface at the quarry site is flat, and to drain off the surface waters a drainage canal was also under construction. The quarry will be a pit operation, and sinking of this pit was just being started and will be continued until a 45-ft. face is secured. Core drills have shown that the deposit extends to a depth of at least 138 ft. The company has a lease on 2000 acres of limerock-bearing ground.

The first 4 or 5 ft. of the deposit as now exposed is harder and more compacted than that below, and at present an Armstrong well drill is used to put down 5⅝-in. holes on 12-ft. centers and similar burden, and the holes are loaded with 40% Hercules gelatin dynamite, with the charge distributed so that the upper and harder layer will receive the greater charge. Once the quarry face is opened up, giving the powder an opening to break to, very little explosive will be necessary. A power shovel could almost dig the material without shooting, so all that is necessary is to shake up the formation a little. An idea of the hardness of the limerock can be gained from its drilling rate of 20 ft. per 8 minutes. Incidentally, 15 men will quarry, crush and load 25 to 30 cars per 10-hour day, 50 tons per car.

The limerock is loaded by a 1-yd., Northwest, gasoline-powered shovel, mounted on crawler treads, which loads either of two cars of a type quite common in the rock products fields of the South Atlantic states. These particular cars were manufactured by the Schofield Iron Works of Macon, Ga. The cars, after loading, are hoisted up an incline and end-dumped to a 42-in. single-roll crusher, made by the Ocala Iron Works, which also supplied the hoist.

The roll crusher discharges by gravity to a 50-ton bin directly over the railroad track, from which all the cars are loaded. No other storage is provided or contemplated. The entire plant is belt-driven by a 100-hp.

Westinghouse induction motor, power being delivered by the Southern Georgia Light and Power Co. at 2000 volts and used at that voltage.

The Southern Lime Products Co. is one of the enterprises of S. J. Groves and Sons, Minneapolis, Minn., and has its headquarters at Cordele, Ga. C. H. Groves is president; C. D. Walters, vice-president; W. K. Smellgrove, manager and secretary, and A. W. Davidson is superintendent.

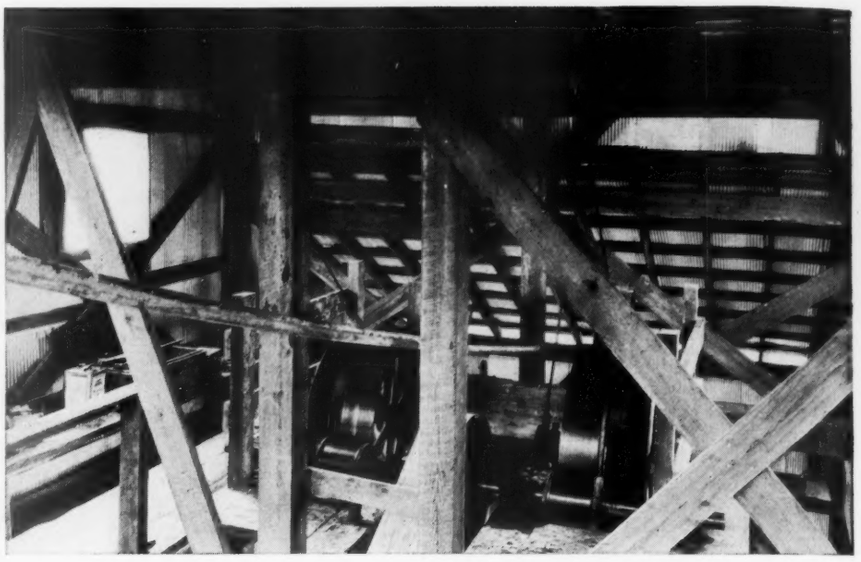
The Granite Areas of the South Atlantic States

In the northern part of the state of Georgia a new crushed-stone operation is ready

One of the belt conveyors in the new plant at Lithonia, Ga.

to start production at Lithonia, which is 25 miles east of Atlanta. This plant was built by the Consolidated Quarries Corp., which interlocks with the Piedmont Corp. This plant is the largest and most modern granite crushing plant in the South Atlantic states, and a complete description of this operation will be published in a forthcoming issue of Rock Products. This plant was all ready to operate, a few weeks ago, and was only awaiting the delivery of trucks for haulage of stone to the primary crushers.

The rock for this plant will be taken from a granite mountain three miles east of Lithonia, Chapel Mountain, a mountain resembling the more famous Stone Mountain, on whose face the Confederate memorial is being carved, although not as high and prominent an uplift of stone as Stone Mountain. The quarry is referred to as the Chapel Mountain quarry and is, roughly, 400 yd. from



Double drum hoists in plant of Southern Lime Products Co.

the new plant. It is one quarry where absolutely no overburden will have to be handled, as the face, sides and top of the mountain are clear and barren.

There is no crushed stone being produced from Stone Mountain, although there is a large dimension stone quarry operating on the side of the hill opposite to where the memorial is being carved. This quarry recently had an air receiver blow up, killing 7 men and injuring 14, and the scene of the accident was visited soon after it happened. This account was published in the March 16 issue of Rock Products, and as a matter of safety first it should be read and studied by all quarry operators.

South Carolina Quarries

South Carolina is another state that has awakened to the need of better highways, and the legislature has passed a bill authorizing the issue and sale of bonds to the extent of $75,000,000, the funds to be used for highway construction. This means that a total of $150,000,000 will be spent in the two states of Georgia and South Carolina during the next three to five years for highway construction, and with the increasing construction of cotton spinning and manufacturing plants, the rock products industry will be quite active.

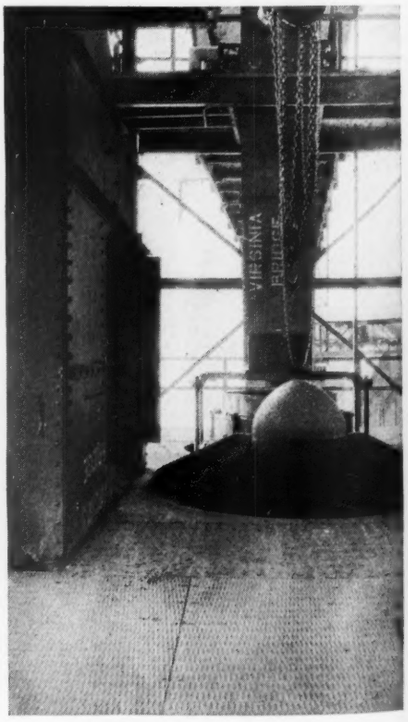
No doubt a considerable amount of stone will be shipped in from the various plants in North Carolina, and with those that are already established and one that probably will be built this year near Augusta, by the Saluda Crushed Stone Co., the plant capacity for handling the stone requirements will be amply taken care of. A cement plant was reported to be under construction in South Carolina, but so far it is in the promotional stage only.

Saluda Crushed Stone Co.'s Operation

This company started operations in 1922, but was burned out in 1928 and the plant rebuilt after the design of W. H. Cook, president. Mr. Cook is also president of the South Atlantic Crushed Stone Association. The offices of both the Saluda Crushed Stone Co. and the South Atlantic Crushed Stone Association are in Greenville, S. C.

The quarry and plant are located 12 miles from Greenville on the Greenville and Northern railroad, and all shipments are made over this road, nothing being shipped by truck.

A small amount of overburden, of 3 to 5 ft., has to be removed. Drilling is accom-



Secondary crusher in Georgia's most modern crushed stone plant

High fragmentation is secured by unusual drill hole loading practices at the Saluda operation

plished by two Keystone steam-powered well drills, holes being on 30-ft. centers with 20-ft. burden and 60 ft. deep. Every other hole is loaded with 75% gelatin dynamite, and the remaining holes with 40%. This rather unusual method of shooting was the outgrowth of considerable experimenting by Mr. Cook in co-operation with the Grasselli Powder Co. The holes are shot with Cordeau-Bickford, and 5 to 6 tons of stone per pound of explosive, with excellent fragmentation, are secured. The rock is a gray, tough granite, hard, but not as hard as some of the other granites in North and South Carolina.

The stone is loaded into 5-yd. Western and Continental dump cars by a 1¾-yd. Marion model 37, full-revolving on crawler treads, and delivered to the plant by either a 7-ton Plymouth or an 8-ton Vulcan gasoline locomotive.

The plant equipment in the order of its use consists of a 42-in. by 40-in. Allis-Chalmers jaw crusher, 5½-ft. Symons cone for grizzly oversize, and a 24-in. inclined conveyor belt elevating crushed granite to a 60-in. by 20-ft. rotary screen. Oversize from the scalper, amounting to 3% to 5% of total, is returned to cone crusher by an 18-in. belt conveyor. Scalper has five sections of "Rol-man" manganese-steel wire. The 8-ft. dust jacket has ½-in. mesh cloth.

Trench in foreground is part of stock pile reclaiming system to be installed at Saluda crushed stone plant

Partial view of quarry shows the amount of overburden to be handled at Saluda Crushed Stone Co.

Screening plant and stock pile of rejected screenings at Saluda operation

The fines from the dust jacket pass over a "Leahy No-Blind" vibrating screen, made by the Deister Concentrator Co., and the oversize from the jacket likewise passes over a second Leahy screen. The various sizes of commercial stone fall to bins for loading, and the fines, minus ¼-in., are stock piled, as very little of this product is salable now in the vicinity.

One of the most interesting things in the entire operation is the tonnage produced by the Symons cone crusher. Mr. Cook stated that in rebuilding the plant after the fire he replaced four small gyratories with the one 5½-ft. cone crusher, without decreasing capacity, and at the same time reduced his minus ¼-in. mesh material, which is here practically a waste product, from 21% to 12%. This condition appears to be duplicated at other granite operations in the Carolinas, increasing tonnage both by crushing more material and decreasing amount of fines.

The plant has a capacity of 1250 to 1500 tons per day, employs 35 men and requires 750 hp. to operate. Air for secondary drilling is supplied by a 600- and an 880-cu. ft. per min. "Imperial," type 10, Ingersoll-Rand compressors driven by 125- and 200-hp. Westinghouse motors, respectively. Power is delivered to the plant by the Duke Power Co. and serviced at 440 volts.

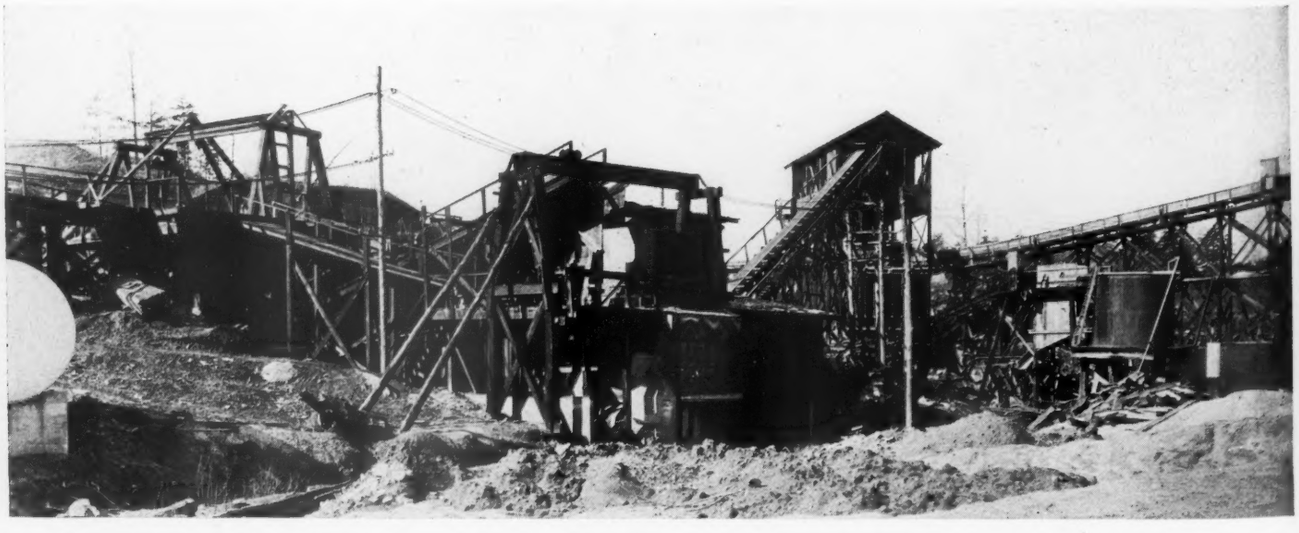
W. H. Cook, president, Saluda company

The company owns a large deposit of granite near Augusta and is contemplating the erection of a plant there some time this year.

W. H. Cook is president of the Saluda Crushed Stone Co.; A. E. McCordic, Rookery Bldg., Chicago, Ill., vice-president; B. E. Harrison, secretary; E. R. Cook, superintendent, and Hull Smart is general foreman and master mechanic.

Holston Quarry Co.'s Operation

A second granite quarry operating near Greenville, S. C., is that of the Holston Quarry Co., whose quarry and plant are located at Beverly. This company strips its deposit hydraulically, and is also changing its method of transportation from track and cars to trucks, having purchased three 7½-ton Mack trucks equipped with 10-ton, Easton, side-dump bodies. From its second pit, which is located several hundred yards from



In foreground is primary and secondary crusher with incline belt conveyor to screening plant towards rear

Two of the trucks that are just being placed in service at the Holston quarry near Beverly, S. C.

the plant, track haulage will be continued, and if the truck method proves satisfactory, the entire operation will be converted to this method.

The company is installing the identical No. 12 Newhouse crusher that was on exhibition at the Road Show and Crushed Stone Convention at Cleveland in February. Mr. Ray Reynolds is superintendent.

At the capital of South Carolina, Columbia, are located two granite quarries and crushing plants, the Weston-Brooker Co. at Cyce, which is a suburb of Columbia, and the Palmetto quarries, which were recently merged with the South Carolina Granite Corp.

Weston-Brooker Co.'s Operation

The Weston-Brooker quarry is one of the oldest in the state and is a pit operation, which has at present reached a depth of 225 ft., with practically vertical walls on all sides. The rock is loaded by hand into steel pans holding 5 tons each, and these are hoisted out of the quarry vertically. The head sheave of the hoist is mounted on an 8-wheel carrier, and this rides the cableway spanning the quarry. One end of the cableway is anchored at a point near the primary crusher, and the other to a car on which is mounted the electric hoisting mechanism, and the car rides in turn on a wide-gage track that circles the opposite half of the pit.

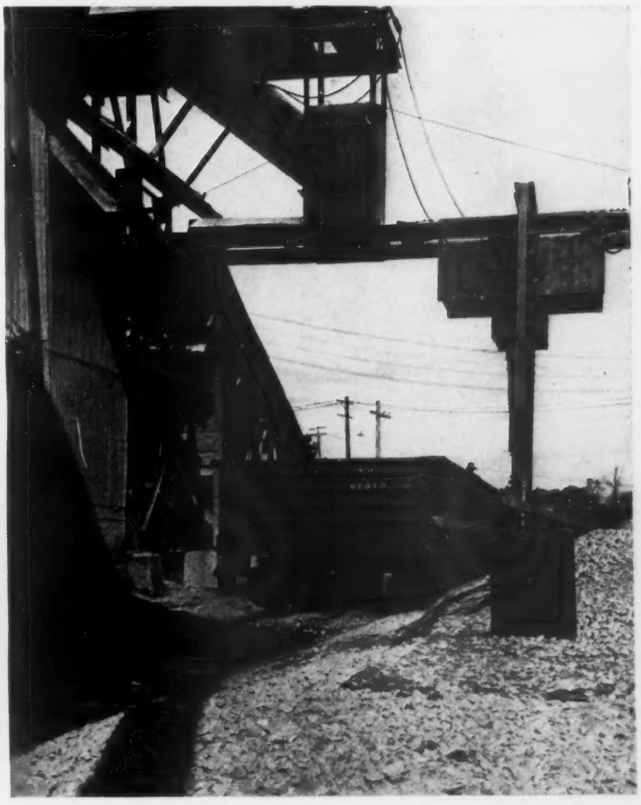
The hoist operator by this arrangement can shift the spanning cableway to any desired point and likewise reach any of the points of loading with the pans. There are two of these devices, both serving the same crusher.

A Genesis of Operating Kinks

The Weston-Brooker quarry has been the scene of many ingenious developments that are today in use in the crushed-stone industry. The Weston crusher is one, and the more recent sample screening device which was on exhibition at the National Crushed Stone Convention and which is being sold to the trade by the Hendrick Manufacturing Co., is another.

A still more recent invention of the Weston brothers is a mechanical device for loading crushed stone into standard gage gondolas so as to prevent segregation of the fines and coarse. The highway specifications

Crushing and screening plant of the Holston quarry with ground storage pile in foreground



Device for loading crushed stone which prevents segregation of coarse and fines at Weston-Brooker quarry, Cayce, S. C.

for South Carolina have become so strict that if crushed stone is loaded from an ordinary chute, complaints often arise due to the tendency of the coarse materials to fall to the outside and the fines in the center. This device is a mechanical spreader that travels back and forth over and across the width of the car, with a suitable baffle arrangement to insure further mixing. There is also provision for a small amount of longitudinal movement of the spreader so that exact spotting of the car to be loaded is not imperative.

The spreader is operated by a small Ingersoll-Rand compressed air hoisting engine, the valve mechanism of the hoist being remodeled and two small air cylinders provided, the whole so constructed that the carrier is automatically reversed at the end of each trip across the car. On the outboard end of the hoisting engine a means has been provided for controlling the air valves, opening and closing so as to reverse the engine's direction. Power is transmitted from the hoisting engine to the spreader by a ⅜-in. cable.

Associated Companies

Across the Congaree river from the Weston-Brooker quarry is the Palmetto quarry of the South Carolina Granite Corp. This corporation interlocks with the Raleigh Granite Co. and the Hiddenite Granite Co., and these three operating companies direct the destinies of eight crushed granite operations in North and South Carolina, two, the Palmetto quarry and the newer plant at Blairs, S. C., being in the latter state.

One of the six wheeled cableway pan carriers at the Weston-Brooker quarries

The executives of the three above companies, as well as the Granite Curb Co., another subsidiary, are shown below.

	Raleigh Granite Co.	Hiddenite Granite Co.	South Carolina Granite Corp.	Granite Curb Co.
President	Robert G. Lassiter	W. H. Ragland	George D. Lott	W. H. Ragland
Vice-President	E. U. Ragland	E. V. Correll	H. B. St. Lawrence	Albert Brown
Treasurer	W. T. Ragland	W. T. Ragland	W. T. Ragland	E. U. Ragland
Secretary	George R. Goodwin	B. W. Parham	Van Lott	E. U. Ragland
Assistant Treasurer and Assistant Secretary	H. M. Shaw	Thomas White	D. E. Saunders	

Blairs Operation of South Carolina Granite Corp.

This is the newest plant of the Robert G. Lassiter interests, operated under the name of the South Carolina Granite Corp., and was built primarily in anticipation of road-building activities in South Carolina. This plant was built under the direction of W. T. Ragland, construction work starting in February, 1928, and operations in June of the same year.

Two quarries are being opened up within 150 to 200 yd. of the plant, and the overburden is removed by hydraulic means. For this purpose two centrifugal pumps capable of delivering 3200 g.p.m., at 170-ft. head, are used, each driven by a direct-connected, 200-hp., electric motor. Georgia Iron Works

Cableway carrier at the Weston-Brooker quarry

The face of the quarry at the old Palmetto operation near Columbia, S. C., showing the movable terminal car on the rim in which is mounted the hoist for operating the cableway that transports the pans to the plant

monitors are used. Owing to the nature of the overburden, a high water pressure is not so essential as is a large volume, the material being easily removed by the nozzles at the pressure given, but a large volume of water is necessary to keep it moving.

Drilling is done by four Sanderson-Cyclone, electric, well-drills, and four, X-71, Ingersoll-Rand, tripod drills. Six Ingersoll-Rand "Jackhamers" are used for secondary drilling. Gelatin dynamites, 60% strength, are used for explosives, detonated with Cordeau-Bickford.

Churn drills at work at the Weston-Brooker quarry. This is said to be the hardest and toughest granite in the Carolinas

The stone is loaded by two 2-yd., 50-B Bucyrus, electric shovels and an auxiliary 1½-yd. Link-Belt shovel into eight 5-ton Mack trucks, both end- and side-dump, after which the granite is hauled an average distance of 800 ft. to the 60-in. by 48-in. Allis-Chalmers primary jaw crusher. This crusher is driven by a 200-hp. Allis-Chalmers motor through a Tex-rope drive.

Convict labor loading stone at a South Carolina crushed granite plant

The primary crusher discharges to a 48-in. belt conveyor which serves a bar grizzly, the oversize from which passes to an 18-in. Superior McCully reduction gyratory set to 2¼ in. This crusher is also driven by a 200-hp. motor with a Tex-rope drive.

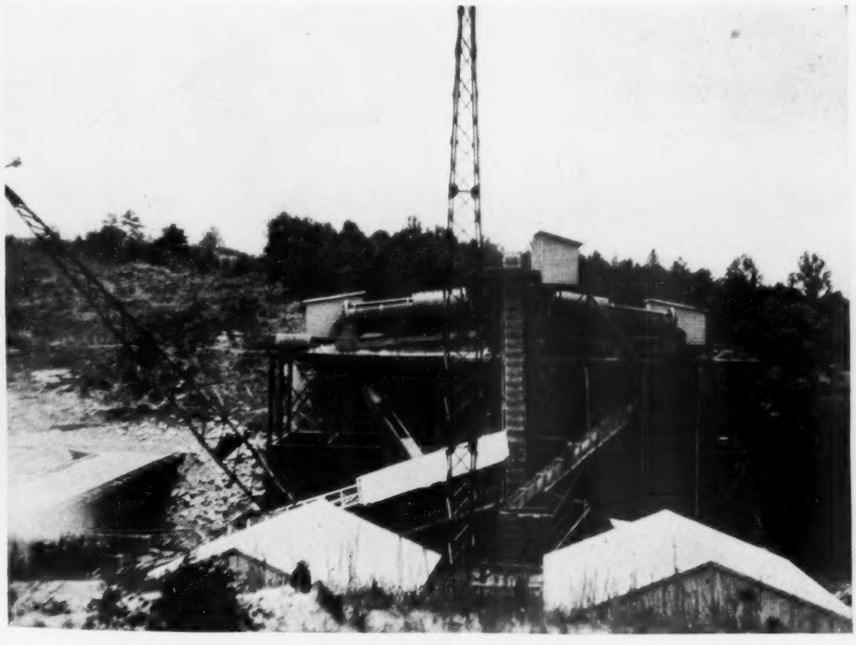
The fines from the bar grizzly, and the McCully crusher discharge, join and are elevated by a 36-in. bucket elevator driven by a 40-hp. motor through a Cleveland spur-gear reduction unit. This elevator serves two 72-in. by 20-ft. Allis-Chalmers rotary screens, both driven by 25-hp. motors through Cleveland geared reduction units.

The first screen, or left-hand screen, as it is referred to, has a 9-ft. dust jacket of 3/16-in. wire cloth, the main barrel consisting of 10 ft. of 1¼-in. round perforations, and 10 ft. of 2¼-in. The fines, minus 3/16-in. material, are stock piled. The oversize from the dust jacket passes to two Stephens-Adamson Gilbert screens, the inner screen having ½-in. and the outer 3/16-in. perforations, where the ½-in. to ¾-in. and 3/16-in. to ½-in. sizes are made and also washed a second time, the first washing being at the two Allis-Chalmers rotary screens. The minus 3/16-in. material from the Gilbert screens is also stock piled. The 1¼-in. to 2¼-in. falls to bins. The oversize (plus 2¼-in.) from the left-hand rotary is chuted to a 4-ft. Symons cone crusher.

The right-hand rotary screen also has a 9-ft. dust jacket of 3/16-in. wire, and the fines are similarly stock piled.

The main barrel here, however, has 10 ft. of ¾-in. perforations and a 10-ft. end section of 1¼ in. The oversize passes to a belt conveyor and is delivered to the Symons cone crusher. The discharge from this crusher returns to the system ahead of the two rotary screens.

The cone crusher is driven by a 100-hp. motor and the Gilbert screens each by a 10-hp. motor. Water is supplied for washing by two centrifugal pumps, each of 800-g.p.m. capacity, at 170-ft. head, and are driven by two 75-hp. direct-connected motors. The plant employs 100 men and has a capacity of 2500 tons per day. S. T. St. Lawrence is superintendent.



Newest plant of the South Carolina Granite Co. at Blairs, S. C.

Palmetto Quarry Operation

The Palmetto quarry of the South Carolina Granite Corp. is a pit operation using a cableway system for transporting the stone from pit to primary crusher similar to that in use at the Weston-Brooker quarry. This cableway has a span of 538 ft. and the main carrier cable consists of 2½-in. track strand,

91 wires, and had given 27 months' service when the quarry was visited—and still good. American Steel and Wire Co. cable is used.

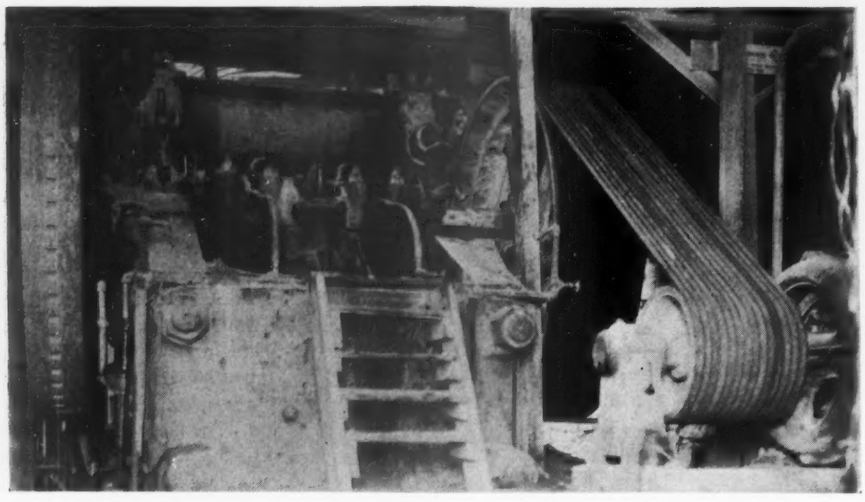
The quarry at present has a depth of 220 ft., and the rock after hand-loading into pans can be delivered to the plant by the cableway referred to or by stiff-leg derricks mounted on the quarry edge. A third delivery alternative is for another stiff-leg derrick to hoist the pans from the quarry, discharging them to cars, after which they can be delivered to the plant by means of a trestle skirting the edge of the pit. This plant employs 170 men and has a capacity of 150 tons per hour. A total of 525 hp. is required to drive the various crushing and screening equipment. T. M. Hanna is superintendent.

Another view of the Blairs plant

The Raleigh Granite Co.'s Operation

This company operates four plants in North Carolina and is affiliated with two other operations in that state, as well as with two in South Carolina. The South Carolina operations are at Columbia and Blairs. The former plant was the old Palmetto quarry Co., which was consolidated with the new Blairs plant, and both are now known as the South Carolina Granite Corp., with offices in Columbia. The combined capacities of this group of quarries total 180 cars per day, of which roughly 12%, or 22 cars, is classified as screenings, and in most cases is stock piled. The demand, however, for these screenings is limited, and the production far exceeds the present demand.

The market for the stone produced by the Raleigh Granite Co. and its affiliated concerns is mostly in the Carolinas, with some shipments into Georgia and Virginia, although gravel competition cuts off any longer hauls into this latter state.



Jaw crusher and drive at the Blairs plant of the South Carolina Granite Co.

General view of the Palmetto plant of the South Carolina Granite Co.

One advantage that the Raleigh company has, with its plants so widely scattered over the state, is that shipments can be made direct to consumers without any extra railroad transfer charges, and also it is able to supply considerable ballast to the railroads serving the different plants. Ballast requirements are very strict with some of the railroads, calling for no stone over 2½-in. and with all the minus ⅜-in. material removed.

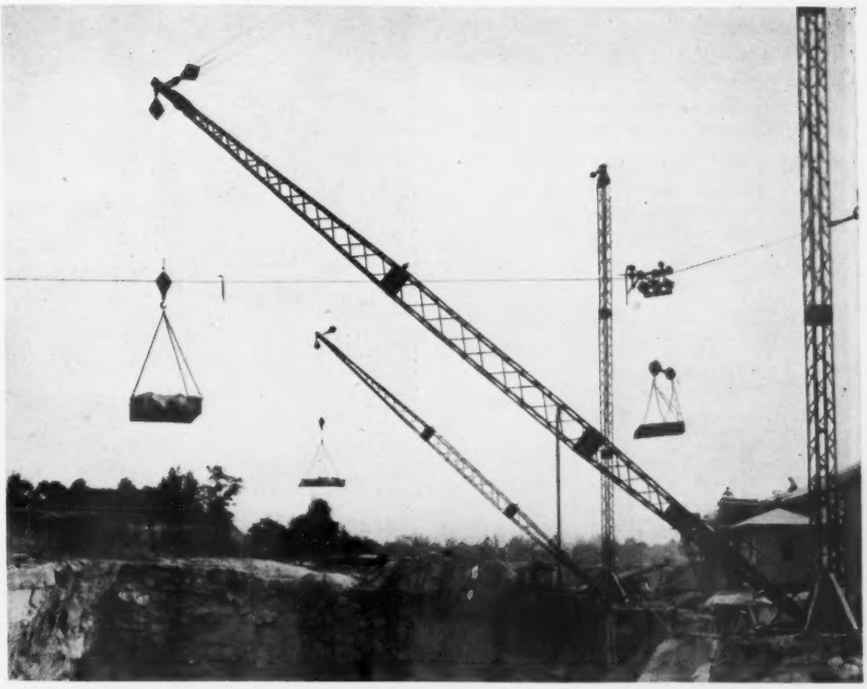
General Conditions in the Carolinas

All of the plants in North and South Carolina are granite operations, the general character of the products being approximately the same; one quarry may have a slightly harder or tougher stone than its neighbor, but in a general way it could be said that the granites are identical. The stone from these quarries has been used in highway construction for many years.

With the two plants of the South Carolina Granite Co. located in South Carolina, and with the possibility of locating one or more additional plants within the coming year in that state, producers will be in a position to meet any demand that will follow the passage of the $75,000,000 bond issue in that state.

The Raleigh Granite Co.'s operations are as follows: Greystone plant, Greystone, N. C.: Rolesville plant, Wake Forest, N. C.; Neverson plant, Simms, N. C., and Rockton plant, Wendell, N. C.

Hiddenite Granite Co. (an affiliated company): Gill quarry plant, Stokesdale, N. C., and Hiddenite plant, Hiddenite, N. C.



Palmetto quarry of the South Carolina Granite Co., showing stiff-leg derrick and aerial cableway for hoisting stone from quarry

South Carolina Granite Co. (also an affiliated company): Palmetto quarry, Columbia, S. C., and Blairs plant, Blairs, S. C.

The capacities of the four Raleigh Granite Co. plants total 70 cars, the Hiddenite Granite Co., 28 cars, and the South Carolina plants, 60 cars. This is based on a 10-hour day, 50 tons per car, and excludes screenings.

Convict Labor Largely Employed

All but one of the North Carolina operations of this company employ convict labor, which is universal practice at most of the other properties in the state. The exception

Part of the Palmetto quarry at Columbia, S. C.

is the case of the Raleigh Granite Co. at its Greystone plant.

Three of the plants of the Raleigh Granite Co. use convict labor for hand-loading, and both the plants of the Hiddenite company as well. Hand-loading is popular in this district, as it permits a much smaller capital investment per ton produced and results in a larger number of different operations at locations advantageous for cheap freight hauls than would be the case with a centrally located, larger plant and quarry operation.

The movable carriage mounted on heavy rails houses the hoist mechanism for handling pans via the overhead cableway at the Palmetto quarry

Greystone Operation of the Raleigh Granite Co.

The rock here is a hard gray granite which is, on the average, harder than any in the state. The quarry of the Weston-Brooker Co., at Columbia, S. C., is perhaps the only one producing a harder stone in either of the Carolinas. The Greystone quarry is one of the oldest in the state, having been in operation over 50 years. Dimension stone at one time was shipped from here under the name of "Royal Variegated Rubble." Some stone is still shipped under that name.

Loading crushed granite at the Greystone quarry of the Raleigh Granite Co.

The quarry is operated in three benches, and the total depth of the floor is 225 ft. The crushing plant is placed on the brink of the quarry, which, at this point, is a single, vertical, unbroken face. At this point it might be mentioned that as conditions are ideal for a vertical skip arrangement from the lower quarry floor to the primary crusher directly above, the management is seriously considering an arrangement of this nature and the use of motor trucks for quarry transportation in place of the present rather elaborate industrial trackage system.

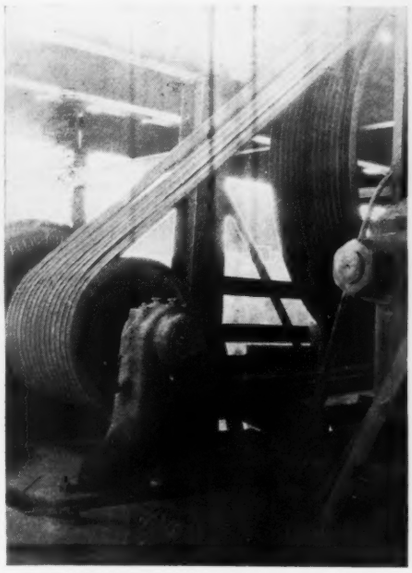
Newly rebuilt portion of the Greystone plant that was recently destroyed by fire

The main source of stone at present is from the second bench, and here three electric Sanderson-Cyclone well-drills are operating, drilling holes with 22-ft. centers and 22-ft. burden to a depth of 76 ft., which is 4 ft. below the mean quarry floor. The holes are loaded with 60% du Pont gelatin and exploded in groups of 10 to 35 holes, using Cordeau-Bickford detonating fuse. About 3.5 tons of stone per pound of powder is secured. The upper and lower benches are drilled with three, X-71, Ingersoll-Rand, tripod drills, and secondary drilling is done with jack hammers, of which there are 12 in service. The company uses seven tons of drill steel per year at this quarry.

Loading is done by two 50-B Bucyrus shovels, one electrically driven and the other

This conveyor belt has been in service five years and handled 1,250,000 tons of primary crusher discharge material at the Greystone plant

Diesel-engine powered. Both are equipped with crawler treads and have 2-yd. buckets. In addition, a 1¼-yd., steam-driven, Marion shovel is also available, this being one of the oldest pieces of equipment at the quarry and still doing good work.



Driving a 60x48-in. jaw crusher at the Greystone plant. A similar drive is used at the Blairs operation

The rock is loaded into company-built cars holding five tons each, which are switched to the foot of one of the two steep inclines (one of the inclines has a slope of 55 deg.)

This hoist serves two inclines, the cables passing through suitable sheaves at left. Greystone plant of Raleigh Granite Co.

by one of four 8-ton Plymouth gasoline locomotives, after which the cars are hoisted to the top of the quarry by an American Hoist and Derrick Co. 2-drum electric hoist. This piece of equipment is driven by a 135-hp. General Electric motor through open-gear reductions, that drive the drums at 300 ft. per min., rope speed, and exert a 10,000-lb. line pull. Leschen "red strand" wire rope is used throughout.

At this intermediate level another Plymouth locomotive switches the cars to the foot of the second incline where the cars are hoisted, one at a time, and dumped into a 60-in. by 48-in. Allis-Chalmers jaw crusher. This crusher is driven by a 200-hp. Allis-Chalmers induction motor through a 14-strand Tex-rope drive. This drive is said to be one of three installations of the kind, a similar drive being also at the Blairs, S. C., plant.

The primary crusher discharges to a 36-in., 8-ply belt conveyor which elevates the material through an angle of approximately 20 deg. This conveyor, which is on 188-ft. centers, discharges to two No. 7½ McCully gyratories. The belt at present is heavily overloaded, and it is planned to install a wider conveyor for this work. The particular belt now in service was supplied by the Quaker City Rubber Co. and has been in continuous operation for over five years,

General view of the Greystone pit near Raleigh, N. C.

during which time it has handled upwards of 1,250,000 tons of relatively coarse, very abrasive stone.

The discharge from the secondary crusher passes to a 36-in. belt bucket elevator, which serves a 60-in. by 30-in. Good Roads Machinery Co. rotary screen, equipped with an 8-ft. dust jacket, 3/16-in. mesh wire. The first 9 ft. of the barrel proper has ¾-in.

E. V. Ragland, vice-president of Raleigh Granite Co., and O. V. Frady, superintendent of the Greystone plant

round perforations, then 12 ft. of 1¼-in., and lastly 9 ft. of 2½-in. The fines from the dust jacket are carried by the wash water that is first introduced at the head of the bucket elevator and into the barrel of the screen as well, to a Link-Belt sand classifier. The fines flow to a series of settling ponds from which the water is returned to the system.

The oversize from the dust jacket (3/16-in. to ¾-in.) falls to a double-deck "Hum-mer" screen, the upper deck having ⅜-in.

Three inclines are necessary to serve the 41 loading tracks at the Wake Forest plant

square openings and the lower ⅛-in. The oversize from the upper deck falls to bins below; the ⅛-in., ⅜-in. or throughs from the upper deck likewise fall to bins, and the fines from the ⅛-in. lower deck join the fines from the rotary screen's dust jacket.

The 1¼-in. stone from the second section of the rotary washer falls to a single-decked,

Plant and quarry of the Raleigh Granite Co. at Rockton, N. C. Note convicts leaving quarry

Neverson operation of the Raleigh Granite Co.

"Hum-mer" screen, equipped with ⅛-in. wire, the fines also passing to the Link-Belt sand classifier and the cleaned oversize falling to bins below. The 2½-in. stone from the end sections falls to bins below. The oversize is chuted to either a No. 6 McCully gyratory or a Weston crusher, or both, and their discharge joins the discharge of the two No. 7½ McCully's. These four crushers, secondary and finishing, are to be replaced with a 7-ft. Symons cone crusher, as considerable experimental work has recently been done, and owing to the peculiar way in which this granite breaks, it has been found that large capacity can be secured and a reduction in fines (3/16-in. material which is practically wasted) can be made from 27% to 12%. It may be necessary to put in a third tailings crusher, but this is unlikely.

The plant has a connected load of 1400

hp., employs 78 men, and has a capacity of 25 to 30 cars of crushed stone per 10-hour day, which after washing and rejection of the screenings gives a capacity of 20 to 25 cars per day of commercial material.

At one time rock was hoisted from the pit by means of three stiff-leg derricks, two of which are still standing and are now used solely for making crusher and mill repairs.

The stone from the bins is drawn direct into cars below, and during slack seasons these cars are dropped to the storage switch and unloaded by a 1¼-yd. Brown, steam-driven, clamshell hoist.

Air is supplied by one Imperial, type 10 X-C B, Ingersoll-Rand compressor, 1200 cu. ft. per min., 2-stage, 20-in. by 16-in., low compression cylinder, 12½-in. by 16-in. high compression (110-lb. pressure), and is driven by a 200-hp. General Electric motor through a 16-in. leather belt with short center drive. The Raleigh Granite Co. has a total of six of this type of compressor at its various plants, one being at the Rolesville operation.

At the Greystone plant water for washing is taken from the foot of a series of settling ponds and is delivered by a 1000-g.p.m. direct-connected, Worthington centrifugal pump, through 1000 ft. of 8-in. casing, to an upper storage bin. Water from this storage basin is delivered to the plant by two 800-g.p.m., direct-connected, Worthington centrifugal pumps. The water originally is seepage from the quarry, which is delivered to the plant by a small centrifugal pump and only in sufficient quantities to make up mechanical losses.

Rolesville plant, Raleigh Granite Co.

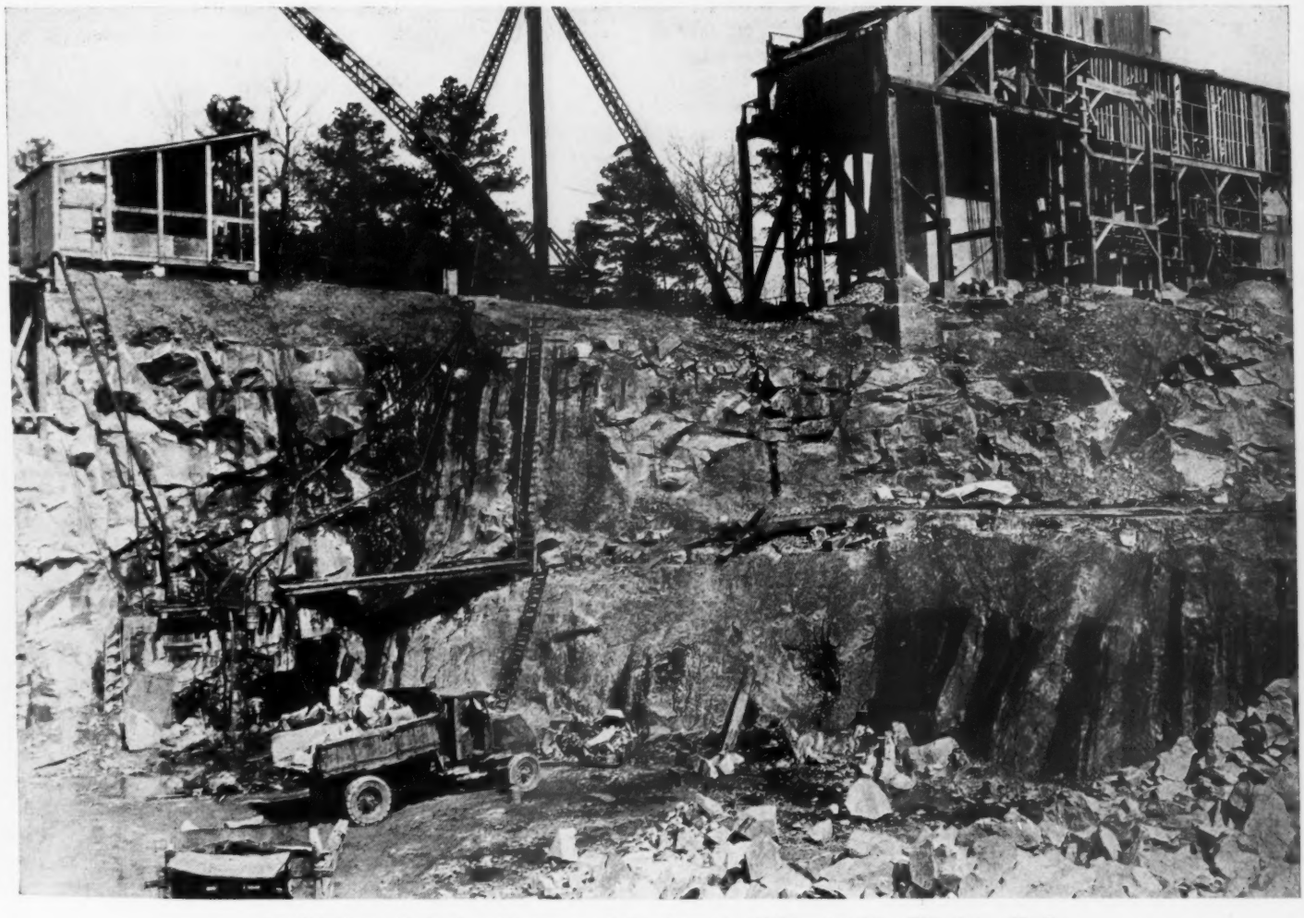
O. V. Frady is superintendent, J. D. Lane plant foreman, and H. M. Douglas, quarry foreman.

Rolesville Plant of the Raleigh Granite Co.

The rock from this quarry is loaded entirely by convict labor, there being 115 convicts employed in the pit and in the plant. There are 15 other men employed by the company, and the state maintains seven armed guards and a convict supervisor. The state is paid for the number of men employed. Any rock loaded in excess of 15 tons, the company gives the convict an additional bonus of 15 cents per ton. It is not to be inferred that the state receives only 15 cents for 16 tons of rock, as the company pays a fair day's wage for the minimum tonnage. Some of the men earn bonuses of $8 to $10 per week. All this convict labor is colored, no white convicts being employed, for it has been found with whites that they gave more trouble than they were worth, refusing at times to work at all.

It is very seldom that any attempt to escape is made, as the guards are posted at convenient places around the rim of the quarry, which is a pit, and their double-barreled shotguns and rifles are impressive.

As in the case of the Greystone quarry, very little stripping was necessary during early operations, and at present the rock is being recovered by sinking, although some lateral expansion is necessary to make room for the 41 loading tracks, there being eight tracks on the second level and 33 on the main or upper bench. Each track is served by two convicts loading a 2½-ton, end-dump



Partial view of plant and quarry of Carolina Road Granite Co., Elm City, N. C.

car. No tracks are laid on the lower floor, as any rock recovered there is loaded into pans and hoisted by a stiff-leg crane, where the material can be dumped direct to the crusher. This level, however, is being used as one source of rip-rap stone, which is in demand at present by the railroads owing to the heavy rains and subsequent washouts. In the event more rip-rap is needed that can be supplied from this pit, cars on the other two levels are loaded and dumped to pans that are placed over the primary crusher, where they are transferred to the cars. At the time of inspection no rip-rap was being loaded, but 15 cars were to be loaded the

Wagon drills in quarry of Carolina Road Granite Co., near Elm City, S. C.

following day, so each convict was sorting out any one-man sized stone and storing it alongside his track for convenient loading the day following.

Another interesting feature of this quarry is that at the time of its establishment in 1922, the company sent a representative north to secure orders for dimension stone. He returned with enough orders to run the place a year, but owing to the demand for crushed stone which started about that time, these dimension stone orders were "farmed out" to other concerns.

Now that highway construction demand has slackened, the company is opening the dimension stone quarry and is installing a second stiff-leg derrick and surfacing machines.

The stone for crushing is delivered to the foot of the three inclines, two inclines for the main level and one incline for the second level, by the loaders, and the cars are hoisted and dumped to a 16-in. Allis-Chalmers gyratory. Some of the cars are dumped to a No. 6 McCully gyratory, which here acts as a primary and secondary crusher as well.

These crushers discharge to a two-chain, 24-in. bucket elevator that serves a 60x20-in. Allis-Chalmers Manufacturing Co. rotary screen, equipped with a 7-ft. ¾-in., round-perforated, dust jacket. Wash water is supplied at the discharge of this elevator and in the rotary as well. The barrel of the drum proper has 12 ft. of round 1¼-in. perforations and 8 ft. of 2½-in. The fines from the dust jacket (¾-in.) fall to a 7-ft. Gilbert washer with ⅜-in. perforations. The oversize (⅜-in. to ¾-in.) falls to bins below, and the fines flow to settling ponds. The ¾-in. to 1¼-in. stone and the 1¼-in. to 2½-in. stone fall to steel bins below. The oversize is chuted to the previously described No. 6 McCully and a No. 5½ McCully gyratories, and their discharge joins the primary crusher's at the bucket elevator.

This plant is one of the most efficient plants in the district, producing 20 cars of crushed stone and five of screenings, with a connected load of 685 hp. The use of convict labor, in cost, compares very favorably with power-loading costs, and permits of a large tonnage with a small primary crushing unit, as all stone crushed there is of necessity one-man size. Likewise, the washing of stone not only produces a cleaner material, but permits the use of smaller meshed screens on the dust jackets, and still produces a material free from fines, thus giving a larger tonnage of merchantable stone, to say nothing of better working and health conditions.

This stone is not so hard to drill as that at Greystone, and has a smaller specific gravity (2.53), which is a very favorable feature from a selling standpoint, as well as lending itself to cheaper production costs. Until lately all drilling was done by a battery of three, X-70, Ingersoll-Rand, tripod drills and 13 jackhammers, but at present one Sanderson-Cyclone well-drill is drilling a round of holes on 15-ft. centers with 15-ft. burden. This smaller center-to-center distance is deemed necessary, as the rock breaks

Trucks discharge to pans similar to this one at crushed granite operation at Elm City, N. C.

more into rectangular blocks than at Greystone. Du Pont 60% gelatin dynamite and Cordeau-Bickford as a detonator are used for blasting. This plant also has a No. 50 Leyner drill sharpener and oil heaters, and uses six to seven tons of drill steel per year.

Crushed stone for shipment can be loaded direct to cars passing under the bins or chuted to a point alongside the bins where the material is transferred to storage by a Sauerman scraper bucket. Owing to the strictness of the highway department, this method of storing crushed stone has not proved satisfactory on account of the tend-

Quarry of the Trego Stone Co. near Emporia, Va.

ency of the stone to segregate, the fines accumulating in the central portions and the coarser material at the edges. Reclaiming is done from storage by a steam, clamshell hoist.

J. H. Rogers is superintendent, J. H. Watkins is mill foreman, and D. C. McGill is pit foreman.

South Carolina Road Granite Co.'s Operation

Another crushed granite operation in North Carolina is that of the South Carolina Road Granite Co., near Elm City, a plant which for the past several months has not been in operation, but is again active at this time. This also is a pit operation, and stripping is not necessary at this stage of operations.

This rock is a very hard gray granite and is drilled with Ingersoll-Rand wagon drills and shot with 70% Trojan starch powder, when the holes are dry; when water is encountered, 60% gelatin dynamite is used. Four tons of stone per pound of powder is secured.

The rock is loaded by a 50-B Bucyrus electric shovel, 1¾-yd. dipper, to three 7½-ton Mack trucks, equipped with Wood hydraulic hoists, which discharge to pans, and the pans are then elevated up the vertical face of the quarry by a stiff-leg derrick, where they are dumped to a 48-in. by 60-in. Traylor "Bull Dog" jaw crusher. The crusher discharges over a 4-in. grizzly, the oversize passing to a No. 10, type T, Traylor gyratory, which feeds a short bucket elevator. The elevator serves a 60-in. by 15-ft. scalping screen, having 2⅝-in. perforations, the oversize falling to two Austin gyratory crushers. The fines from the scalper and crusher discharge to a 60-in. by 24-in. Austin rotary screen with an 11-ft. dust jacket, 1-in. mesh. The minus 1-in. material from the dust jacket passes to a Universal vibrating screen, the oversize and fines from which fall to separate bins. The Austin rotary screen has one 4-ft. section of 1¼-in., 1½-in., 1⅝-in., 2½-in. and 2⅝-in. round perforations, and the desired sized stone from this screen falls to bins below.

The fines from the 4-in. grizzly is carried by a 24-in. belt to the "mud" plant, where, by means of a 24-in. bucket elevator, the product is delivered to a 60-in. by 18-ft. Allis-Chalmers rotary screen with the first two sections of 1¼-in. round perforations and a 2¼-in. and 3-in. perforated section following. The products passing the last two sections are chuted to railroad ballast bins. The material through the first two sections passes to a second Universal screen, of 1½-in. wire mesh. The fines from this screen is mostly dirt and is rejected.

The oversize from the Universal screen (and this is a rather unusual procedure) with the oversize from the Allis-Chalmers rotary screen pass to an Austin gyratory crusher, and this discharges so that the material joins that from the other two Austin crushers. By crushing in this manner, the stone, which is still more or less mixed with some earthy material at this point, is loosened from the adhering dirt. The subsequent screening operations effectively remove this loosened material.

Crushing and screening plant for railroad ballast at Trego Stone Co.

The plant is driven by a series of electric motors in conjunction with several countershafts, power being supplied by the company from its own generating plant. The company has two 150-hp., one 180-hp. and one 240-hp. Fairbanks-Morse generators, the exception being that one 150-hp. Diesel-engine unit drives a 10x12-in. Chicago Pneumatic Tool Co. air compressor. A single-cylinder, Ingersoll-Rand, 12x12-in., type ER-1, compressor is also available.

The plant has a capacity of 1000 tons of crushed stone per day and employs 50 men. Shipments are made over the Atlantic Coast railroad lines, loading either direct to cars from bins or from ground storage. Storage reclaiming is done by an Industrial Works Co. crane equipped with a 2-yd. Hayward bucket. W. B. Bobbitt is general manager and J. C. Fisher is superintendent of the Elm City plant.

Trego Stone Co.'s Plant in Virginia

This company operates at Emporia, Va., just over the line from North Carolina and directly north of the Elm City operation just described. The operation at Emporia is the largest single unit visited in the South Atlantic states, having a capacity of 3500 to 4000 tons of crushed stone per 10-hour day. This comparatively new plant was described in the June 11, 1927, issue of Rock Products.

The Trego Stone Co. has a rather large ballast contract from the Atlantic Coast railroad and is operating to full capacity, disposing of its entire output, screenings as well as ballast to the railroad, and practically none of the stone is shipped for commercial purposes.

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Production of Magnesia and Silica Crucibles

C. N. SCHUETTE, assistant metallurgist at the Berkeley, Calif., station of the U. S. Bureau of Mines, has conducted researches to develop silica crucibles of greater wall thicknesses than could be fabricated from fused silica and also to produce magnesia crucibles of greater density and mechanical strength, with heavier walls.

In his report, No. 2896, published by the Department of Commerce, U. S. Bureau of Mines, October, 1928, he describes the methods used for producing crucibles with a capacity up to 250 c.c. in a specially designed induction furnace, and includes details of the furnace construction and operation.

The raw material for the magnesia crucibles was 60-mesh, periclase, 95.10% MgO, which after forming into the desired shape was subjected to a temperature estimated between 2400 and 2800 deg. C., resulting in a satisfactory crucible. Similarly he describes methods used for manufacture of silica crucibles, using Ottawa sand, assayer's sand and material from crushed crucibles.

The Stability of Chert

A Discussion of the Effect the Presence of Chert in Aggregates May Have Upon the Concrete

By Dr. Herbert F. Kriege
In Charge of Tests, France Stone Co. Laboratories, Toledo, Ohio

WITHIN recent years the advance in the science of highway construction has induced a more careful scrutiny of the materials used in that field. Attention has been called to the characteristics of each type of material, its merits and its defects.

In the realm of concrete aggregates the mineral chert has been given some consideration since it was found that certain cherts do not withstand weathering as well as do their associated limestones. This has aroused a fear in the minds of some construction engineers regarding the use of limestone from deposits which carry appreciable amounts of chert. The literature yields few data concerning this matter. Hence it is considered worthy of attention to discuss a few field observations and some laboratory work relating to the stability of chert.

No mineral as common in our sedimentary deposits suffers as much from ambiguity as does chert. Even at the hands of geologists and mineralogists it passes as a synonym of flint. Yet with flint we have commonly associated the idea of stability and permanence while chert has been rated as unsound at times. The following quoted definitions will help to show our lack of definite knowledge regarding chert, but each will also contribute something to the better comprehension of this form of silica and its occurrence and origin:

Some Definitions of Chart

"Hornstone—Resembles flint, but is more brittle, the fracture more splintery. *Chert* is a term often applied to hornstone, and to any impure flinty rock, including the jaspers." E. S. Dana—A Textbook of Mineralogy (1922), p. 406.

"Chert—Includes varieties of silica with a horn-like appearance, also impure flints and jaspers." Kraus and Hunt—Mineralogy (1920), p. 224.

"The indurated ooze called chalk has its siliceous content gathered into concretions or nodules of *flint*. This is derived from a variety of silica-secreting organisms, as sponges, radiolarians, diatoms, etc. It is to be expected that many limestones should contain much siliceous matter, which if concentrated is known as *chert* or *hornstone*. The Corniferous limestone is so called from its characteristic abundance of hornstone (Latin, *cornu*, horn)." J. Le Conte—Elements of Geology (1905), p. 169.

"*Flint*, an opaque impure chalcedony; *chert*, an ill-defined term applied to an impure flinty rock."—Chamberlain and Salisbury—College Textbook of Geology (1909), p. 38.

"Limestones are also very liable to a process of silicification, resulting in the formation of *chert*." R. H. Rastall—Physico-Chemical Geology (1927), p. 152.

"Next in abundance as a petrifying medium is silica, most commonly in the chalcedonic form, but also as quartz. It is specially frequent in some limestones, as chert and flint, replacing the carbonate of lime in mollusks, echinoderms, etc." Archibald Geikie—Textbook of Geology, Vol. II (1903), p. 831.

H. C. Sargent states: The term "chert" is used to signify a non-elastic sediment consisting essentially of crypto- or micro-crystalline silica and having typically a vitreous luster and conchoidal fracture." *Geol. Mag.*, V. 60, No. 703, p. 163 (1923).

Possibly the easiest distinction between minerals is on the basis of color. W. A. Tarr thus distinguishes between cherts and flints: "Chert includes those crypto-crystalline varieties of quartz which are opaque, save on thin edges, and are white, pink, green, grey or blue-grey in color. By flint is meant the dark grey and black varieties of the same mineral." This is from "The Origin of Chert and Flint." University of Missouri Studies, Vol. 1, No. 2, p. 2 (1926).

Robert B. Sosman in "The Properties of Silica," p. 157 (1927), classes the micro forms of silica in the following manner: "Chalcedony = waxy, translucent, natural, micro-crystalline-fibrous silica.

"Flint = cloudy, dark grey or brown or black, opaque, natural, micro-crystalline silica.

"Chert = any opaque natural micro-crystalline or micro-aphanatic silica whose structure or environment does not permit it to be otherwise classified."

There is much merit in this distinction even though it enlarges the chert group to include all doubtful members of the flint and chalcedony divisions. Evidently chert is a much more abundant and common constituent of our calcareous rocks than we ordinarily believe. No doubt much of the "flint" of the Stone Ages is really chert.

The clearest and most comprehensive conceptions of cherts and flints are given us in the above definitions by Tarr and Sosman. Since these are acceptable, addition or amendment is unnecessary at this time.

Chert occurs in the limestone and dolomitic deposits of many portions of the earth. Every geologic period from the Cambrian to the Pennsylvanian contains chert deposits. Its abundance in such formations as the Burlington in Missouri and the Columbus in Ohio has been noted frequently. It occurs chiefly as nodular or lenticular masses, though sometimes as beds and veins. A common characteristic is a chalky siliceous coating about a very dense center, though frequently this chalky material constitutes the whole mass. There is usually a sharp demarcation between the dense and the friable portions as also between the outer shell and its adjacent limestone.

Origin of Chert

While no attempt can be made here to discuss thoroughly the origin of chert, a few statements concerning it will be helpful when considering some of the characteristics affecting the stability of chert. Probably the most acceptable suggestions regarding its origin have been made by W. A. Tarr (loc. cit.). According to him, cherts were formed by the chemical precipitation of silica from colloidal suspension during the deposition of calcareous muds. Entrapped under subsequent accumulations of muds, these silica gel masses were distorted by pressure into lenticular or nodular forms. Later, desiccation and contraction of the mass produced the changes from an opaline into a chalcedonic mineral. This view seems to describe best the conditions involved in developing a microscopically crystalline to amorphous material, with accidentally enclosed but not essential organic remains and foreign crystalline minerals as pyrite, which occurs in definite horizontal zones even though no bedding planes are present in the accompanying formation.

One of the first field observations of the unsoundness of some chert was made in the spring of 1923 on the concrete pavement between St. Louis and St. Charles, Mo. The road had been opened to traffic the previous fall. Numerous small areas of disturbance appeared, mostly between 1 and 2 in. in diameter. These were either shallow craters or pits from ½ to ¾ in. deep or merely circular or semi-circular cracks outlining the outer rim of a pit in the making. At the center of the pit, when newly opened, could be seen a portion of a piece of chert

aggregate, the other portion forming the apex of the cone forced out of the pit.

F. V. Reagel in an article in *Engineering News-Record,* 93, 332-4 (1924) discusses the tests made in the laboratory of the Missouri State Highway Commission with chert from the aggregate used in the pavement just described. The chert, immersed in water and frozen and thawed repeatedly, was found to split into chips. Likewise small concrete blocks containing much chert as aggregate could be lowered in compressive strength and even disrupted by repeated freezing cycles. The cause of this peculiar behavior was not brought out except to attribute it to expansion effects. A few suggestions regarding the possible causes which will be discussed later are in part the outgrowth of some work begun at that time by the present author when he was a member of the laboratory staff of the Missouri State Highway Commission.

Observation of Pavements Containing Cherty Aggregates

During the fall of 1927, the pavement from Fort Wayne toward Huntington, Ind., was constructed, a cherty limestone aggregate being used. By early summer of the next year numerous zones of disturbances, frequently called "popouts," appeared on the surface of the road. These were not uniformly distributed, in some areas of the pavement there being a dozen per square yard, while in many sections they were difficult to find. Their appearance compared exactly with those observed on the Missouri highway, being less than 3 in. in diameter and ¼ to ¾ in. deep. In all cases the chert pieces were firmly held by the mortar, the splitting having occurred through a fairly large (1 in. plus) piece of chert. It seemed that the pavement was rather free from cracks where these popouts were most plentiful and vice versa, though no definite counts were made to verify this appearance. No increase in the number of pits or incipient pits could be detected during the five months from June to November. In no place was there found to be any connecting cracks between these "popouts" to indicate a spread of the disturbance. Also scattered about the surface could be found many chert pieces from ¼ in. up, entirely unaffected by climatic and traffic conditions, even though they were completely exposed on one side. It is doubtful if the shallow surface pitting caused by "popouts" can have any great effect on the life of the pavement. The small amount of water caught in these depressions would not exert expansive action against the walls because of the flatness of the pit. The danger of such action would be more real in holes with vertical or concave walls such as occur when wood, ochre or clay balls are present in the aggregate.

One other concrete road built of cherty limestone between Waterville and Whitehouse, Ohio, has been observed by the author. This has been in use 10 years without any signs of distress either by pitting or cracking. Likewise the cherty stone now contributing to the pitting of the Indiana pavement discussed has been used for many years in all types of construction without any record of disruption or distintegration. It appears that the distintegrating tendency of some chert is much less than in others or does not occur at all.

In the laboratory investigations dealing with the stability of chert several questions have been answered in part. The first question was: "Is freezing essential to the disintegration of chert of this type or will thermal change alone produce it?" It is conceivable that thermal change alone is the climatic agent producing the result since the phenomenon seems to be confined to the surface of the pavement where the thermal extremes are felt.

To study this factor several series of 8-in. concrete cubes were made using as coarse aggregate 100 per cent chert, cherty limestone (50% chert) and chert-free limestone, all from the same limestone deposit. The mix used was 1:2:3, a good grade of bank sand and a normal portland cement being the other constituents of the batch.

Four of these blocks were set corner to corner to leave an 8-in. cubical opening in the center. The inner faces of the blocks were alternately heated for two hours and cooled for one hour. The heat was produced by a 4-in., cylindrical, electric-resistance heating element extended through a heavy asbestos board directly into the center of the opening formed by the blocks. The temperature attained by the inner face of each block in two hours was 160 to 175 deg. Cent. To provide dry cooling, a pan containing a cone-shaped piece of ice was placed between the blocks and a small electric fan was directed on this ice in such a way that cold air played on the faces of the blocks. In one hour the inner surfaces dropped to approximate room temperature.

This procedure was continued for 100 cycles without any indication of spalling or disruption on the faces of the concrete blocks. Since this action was decidedly more severe than the thermal change endured by pavement exposed to the summer sun's rays, the test was considered a strong indication that the chert in concrete is quite stable to dry thermal shock of this magnitude. The concrete used in these tests had been cured 10 days in moist sand and 4 days in air. The tests continued for a total period of 40 days.

Two series of tests were begun simultaneously in which chert-containing concrete blocks 2½x4x5-in. were tested for soundness as determined by the usual sodium sulphate and water freezing methods. The hand-picked coarse aggregate consisted of 100% chert, cherty limestone (50% chert) and chert-free limestone from three deposits located in Ohio and Indiana. The material was well graded, from ½-in. to 1½-in. The mix was 1:2:3 by volume, portland cement and bank sand being the other materials used. The water-cement ratio was maintained between 0.8 and 0.85. The blocks weighed approximately 2000 grams each after 10 days moist sand and 4 days air curing. They were found to have the following absorption (Table 1) during a 3-hour immersion period at room temperature, average value being given for the duplicate specimens of each type:

TABLE 1

Source R			Source S			Source T		
Chert	Cherty limestone	Chert-free limestone	Chert	Cherty limestone	Chert-free limestone	Chert	Cherty limestone	Chert-free limestone
7.2%	3.4%	3.5%	5.0%	2.8%	2.5%	2.5%	1.5%	1.3%

For the freezing tests the duplicate concrete specimens were immersed in tap water in a galvanized, sheet-iron tank, 9x20x13 in. deep. Around this was packed crushed ice and salt in a well-insulated freezing box. After the freezing had continued for 20 hours at a temperature of about 26 deg. F., the tank and its samples were removed and thawed out on a hot plate to room temperature in four hours. The units were then examined carefully for signs of disintegration. The data obtained during 30 cycles are contained in Table 2.

Results of Tests

It will be observed that a few cracks developed in Samples 1 and 7 after 5 cycles, though not until the 15th and 20th cycle respectively did enough disruption occur to loosen the weakened portions sufficiently to be removed with the hands. In each case the 100% chert coarse aggregate blocks were considered failures by the 30th cycle, three of the six specimens failing about the 20th cycle. Thirty cycles did not injure the units made up of cherty limestone (containing 50% chert) any more than they did the corresponding chert-free limestone aggregates. Sample 3 was the only exception since it came through without a flaw. It appears, therefore, that concrete containing much higher percentages of chert than are found in commercial cherty aggregates can be expected to withstand considerable punishment from freezing and thawing conditions without danger of disintegration.

Concrete specimens duplicating the above series were tested for soundness by the usual sodium sulphate method. The blocks were dried for 4 hours at 100 deg. C. and then immersed at room temperatures in a solution of Na_2SO_4 which had been saturated at 100 deg. F. for a soaking period of 20 hours. Each day the units were examined for signs of chipping, cracks or other forms of distress. The results in the accompanying table (3) form a rather striking contrast with the effect of the freezing tests.

Practically no action occurred during the

TABLE 2.—FREEZING TESTS DATA ON CONCRETE BLOCKS OF CHERT, CHERTY LIMESTONE AND CHERT-FREE LIMESTONE AGGREGATE

	Sample marking								
Cycle No.	1F	2F	3F	4F	5F	6F	7F	8F	9F
1	OK	OK	OK	OK	OK	OK	OK	OK	OK
2	OK	OK	OK	OK	OK	OK	OK	C6	OK
3	OK	OK	OK	OK	OK	OK	OK	OK	OK
4	OK	OK	OK	OK	OK	OK	C2	C4	OK
5	OK	OK	OK	OK	OK	OK	C	OK	OK
6	OK	OK	OK	OK	OK	OK	OK	OK	OK
7	OK	OK	OK	OK	OK	OK	OK	OK	OK
8	C	OK	OK	OK	OK	OK	C	OK	OK
9	C5	OK	OK	OK	OK	OK	OK	C3	OK
10	C	OK	OK	C	OK	OK	C	OK	OK
11	C10	OK	OK	C	OK	OK	OK	OK	OK
12	C	OK	OK	C	OK	OK	OK	OK	OK
13	C	OK	OK	C	OK	OK	OK	OK	OK
14	C35	OK	OK	C98	OK	OK	OK	OK	OK
15	C305 out	OK	OK	C2	OK	OK	OK	OK	OK
16	C	OK	OK	Failing	OK	OK	OK	OK	OK
17	C	OK	OK	C305 out	OK	OK	OK	OK	OK
18	C	C	OK	C	OK	OK	C	OK	OK
19	C6	C	OK	Failure	C	OK	C225	C5	OK
20	Failing	C	OK		OK	C8	C650 out	OK	OK
21	Out	C	OK		C	OK	C	OK	OK
22		OK	OK		C	OK	OK	OK	OK
23		OK	OK		C	OK	OK	OK	OK
24		OK	OK		C	OK	OK	OK	OK
25		OK	OK		C	OK	OK	OK	OK
26		OK	OK		C	OK	C	OK	OK
27		OK	OK		C52	OK	C8	OK	C2
28		OK	OK		C	OK	C	C4	OK
29		C	OK		C	OK	Failure	OK	OK
30		C14	OK		C	OK		OK	OK

1F-4F-7F—Chert for coarse aggregate (100% chert).
2F-5F-8F—Cherty limestone for coarse aggregate (containing 50% chert).
3F-6F-9F—Chert-free limestone for coarse aggregate.
Key to description of freezing test observations:
C—Cracking.
C with numeral following—Indicates amount of material cracked off, in grams.
OK—Passed through individual test satisfactorily.

TABLE 3.—SODIUM SULPHATE SOUNDNESS TEST ON CONCRETE BLOCKS CONTAINING CHERTY AGGREGATE

	R			S			T		
	1S	2S	3S	4S	5S	6S	7S	8S	9S
Immersion showing first action	26	....	....	7	....	....	....	....	....
Material then lost, in per cent	.05	....	....	0.7	....	....	....	....	....
Total cycles	30	30	30	30	30	30	30	30	30
Total loss, per cent	0.25	0	0	0.7	0	0	0	0	0

1S, 4S, 7S—100% chert for coarse aggregate.
2S, 5S, 8S—Cherty limestone for coarse aggregate (containing 50% chert).
3S, 6S, 9S—Chert-free limestone for coarse aggregate.

Difference in Cherts

The most important impression to be gained from the Tables 4 and 5 is that there are *cherts* and *cherts*—some capable of withstanding the accelerated weathering test almost indefinitely without loss, others yielding to its attack within a few cycles. On the basis of the 5-immersion standard adopted quite generally as a highway specification, half of the samples shown would have passed without question and several others would have been accepted. Four of the samples withstood more than 20 cycles, which is the specification tentatively accepted as the measure of stability of materials for trickle filters in sewage disposal. This use is perhaps the most severe treatment imposed on mineral aggregates.

Some uncertainty has been felt regarding the character of the soft chalky layer surrounding so many chert and flint nodules and masses. This has been considered by some to be the less pure transition material between the true siliceous body and its associated calcareous bed. A partial chemical analysis of the soft chalky exterior, the dull white fairly dense interior portion and the dense translucent brown grey center of a 100-lb. chert boulder from the Burlington formation gave the following data:

In this sample at least the material was chemically very uniform from exterior to interior.

first 25 cycles and very little during the 30 cycles. While it has long been a question as to what severity one sodium sulphate cycle represents in terms of freezing cycles, the estimates usually run from 8 to 20. Although these few tests cannot be considered conclusive, they indicate that in the case of chert-containing concrete this corresponding value may be much less, possibly less than unity, since the cherty concrete suffered less in sodium sulfate solution than in the freezing and thawing tests.

Sodium sulphate soundness tests on the above aggregates alone gave results as contained in Table 4.

The effectiveness of the sodium sulphate solution as an accelerated weathering test cannot be doubted as applying to these cherts and cherty limestones. Just what each cycle means in terms of life in normal weathering remains indefinite, however.

Another series of soundness tests covering a wider range of cherts gave the results included in Table 5. The samples from the first four sources are of the dense, grey type, while those from source E include specimens of varying color, translucency and density. Since all of these types are found to have varying resistance to the tests, there seems to be no macroscopic character which will serve as an easy identification for the types that will or will not withstand the disintegrating effect of freezing or of the Na_2SO_4 solution.

TABLE 4.—SODIUM SULPHATE SOUNDNESS TEST DATA ON CHERT, CHERTY LIMESTONE AND CHERT-FREE LIMESTONE

Sample No.	1916	1917	1918	1919	1920	1921	1922	1923	1924
Orig. wt. gms.	635	1900	600	675	1380	605	660	1190	445
No. pieces	10	10	10	10	10	10	10	10	10
Immersions									
1	OK	OK	OK	OK	OK	OK	OK	OK	OK
2	OK	DCS186	OK	OK	OK	OK	C1	OK	OK
3	D313	C41	C3	ChC46	OK	C4	C5	OK	OK
4	C67	D&C227	C45	ChH&C58	Ch5	Ch21	H42	OK	OK
5	C24.5	CH&D204	C36.5	C27	Ch30.5	C3	D565	OK	OK
6	C14.5	DC375	BC98	ABD160	Ch2	B42.5	DC76	C3.5	OK
7	DB79	BC82.5	C21	D120	OK	C7.5	ABC127.5	OK	C7
8	58CD	D114	BC97	B46	C1	A40	DC77	OK	OK
9	58CD	C8.5	C1	BC33.5	C2	C6	OK	OK	C4.5
10	58CD	B80	C18	OK	C1	C14	OK	OK	C12
11	58CD	C2	B109	C25	C7.5	C7	C8	OK	D30
12	C34	OK	C17	C5	C6	D92	C9	OK	C1
Final wt. free sulphate	105	505	145	285	1290	230	175	1185	310
Loss—gms.	530	1395	455	390	90	375	485	5	135
Pct. loss	83.5	73.4	75.8	57.8	6.5	62	73.5	4	3.03

Key to descriptions of soundness test observations: A—Horizontal split into two pieces. B—Vertical split into two pieces. C—Imminent checking and splitting. Ch—Failure around cherty inclusions and limestone contact. D—Complete disintegration by crumbling, etc. H—Horizontal chips from one piece. S—Surface solution effect. OK—Passed through individual test satisfactorily.

TABLE 5.—SODIUM SULPHATE SOUNDNESS TESTS ON CHERTS

Source	Sample No.	Number of pieces	Total original weight	Immersion showing first action—loss over 1%	Pct. material then lost	Total immersions	Total material lost in %
"A"	524-A	1	98.8 grams	41	37.2	41	37.2
"B"	1204	2	622.4 grams	15	1.9	25	2.3
"C"	1986	7	599.0 grams	2	1.3	20	33.2
"D"	1240	1	262.0 grams	3	5.0	10	67.0
"E"	709 (1-10):						
	709—1	1	78.2 grams	24	17.9	41	29.0
	709—2-3-4	3	111.1 grams	No loss	0.0	41	0.0
	709—5-6	2	115.1 grams	5	8.9	41	12.6
	709—7-8-9-10	4	160.3 grams	6	2.5	41	3.1
	957-A	3	168.2 grams	20	3.0	49	4.9
	957-B	1	939.0 grams	No loss	0.0	49	0.0
	1189	2	295.8 grams	17	1.0	25	2.2
	1190	2	336.6 grams	3	1.5	25	5.1
	1191	2	175.2 grams	4	2.8	22	100.0
	1192	3	497.2 grams	2	1.2	25	17.7
	1193	4	1220.7 grams	5	4.2	25	37.8
	1194	2	289.5 grams	17	1.0	25	1.0
	1195	4	864.5 grams	2	3.5	25	53.6
	1196	1	188.5 grams	2	1.1	25	19.4

TABLE 6

	SiO_2	Al_2O_3	Fe_2O_3	CaO	Ignition	Total
Chalky exterior	98.71%	0.05%	0.29%	0.16%	0.71%	99.92%
White dense interior	98.58%	0.11%	0.52%	0.35%	0.42%	99.98%
Translucent brown center	98.32%	0.36%	0.60%	0.27%	0.39%	99.94%

In describing the flints and cherts associated with the Burlington limestones the suggestion appears in the Missouri Geological Survey Paleontology, Part 1 of Vol. IV, that the slaking from dense translucent chert to the friable chalky form takes place quickly upon exposure. The author has never observed this phenomenon, though every opportunity has been taken to watch for it both on freshly exposed quarry faces and in storage piles of crushed stone. Tarr (loc. cit.) considers it a condition produced by the circumstances encountered during or soon after the formation of the chert mass rather than after its exposure. At least it commonly occurs on chert and flint masses. The association of chalky chert with novaculite and tripoli deposits of Missouri, Arkansas and Illinois has given support to the belief that these materials resulted from the decay of chert masses.

A possible cause for the poor weathering properties of certain cherts is suggested in a personal communication of A. T. Goldbeck, director of the Bureau of Engineering, National Crushed Stone Association. He refers to the observation of Dr. E. C. E. Lord, United States Bureau Public Roads, that in one sample of disintegrating chert from Missouri numerous microscopic fissures appeared, whereas in the chert from the vicinity of Buffalo, N. Y., which does not disintegrate, such fissures were absent, or practically so.

Microscopic examination of cherts reveals an irregular structure built up of amorphous, micro-fibrous and micro-granular forms of silica. Thus within this one material may be opaline, chalcedonic and micro-quartzitic silica. The result is a poorly defined texture, variable within the same fragment or thin section. This irregularity of pattern has been noted especially in the cherts examined by the author which showed disintegrating properties. The sound cherts and flints of related members had a much more definite granular, almost granitic, texture when observed under magnification of 75 to 125 diameters and in polarized light. This is not yet to be taken as a sure index of the minerals soundness, but in the dozens of cherts and flints examined both microscopically and for soundness as regards freezing and Na_2SO_4 treatment, this microscopic structural difference has been of most value in predicting soundness.

One of the most common minerals associated with cherts is pyrite. This has been seen in every chert sample examined by the author. In most cases it is microscopically visible, some samples having been found in which the pyrite crystals are several millimeters in length. A very finely divided pyritic mass is sometimes seen coating a chert piece and giving it a brassy green color. More often these sulfide minerals are, as microscopic units, distributed as a specular deposit throughout the mass or in seams and planes. These pyritic bodies soon become oxidized on exposure of the chert and grow into dark iron oxide spots and in time stain the chert mass yellow or brown.

The literature is poor in references to the breaking down behavior of certain cherts on freezing. Hence suggestions regarding its cause are few. With this fact in mind, the following thoughts regarding the causes of instability in some cherts are presented with considerable scientific humility.

Unsoundness of Aggregates

Unsoundness as observed in mineral aggregates is usually attributable to discontinuities of matter or form. Thus, sudden change from crystal to amorphous form or from calcareous to siliceous, clayey or carbonaceous composition within the specimen indicates a point or plane of weakness to disintegrating forces. Applying this principle to cherts we have several points of analogy. The irregularity of texture with the several forms of silica intermingled is the first significant item. The fact that rather regular granular mosaics were observed in cherts and flints which were stable to accelerated weathering and were not found in the disintegrating kinds of chert support this contention. Thus some dark grey to black samples, which, according to Tarr (loc. cit.), should be called flints, have been found to lack the usual granitic pattern and likewise to lack resistance to the soundness tests. Vice versa, many cherts of a light color having this microscopic pattern have also had unquestioned stability.

Second—the presence of pyritic masses either specular or in aggregate encased within a dense medium like chert seems to be capable of inducing such strain under atmospheric changes that rupture of the chert would result. Thus far the author has found no distinctly iron-stained brown chert unable to resist soundness tests whether found in quarry faces or in gravel beds. Reagel (loc. cit.) suggests a stabilizing influence of iron upon the chert. A more logical conclusion seems to be that with the oxidizing of the iron its change from pyritic to oxide form has removed the cause of disturbance.

The suggestion of Reagel that impregnating the chert with silica or iron compounds by stream action accounts for the soundness of chert in gravel by increasing its density has some objections. Chert from gravel has failed in soundness in the tests tabulated in this paper as well as freshly quarried material, though that gravel chert has not been heavily iron-stained. Surely, the conditions imposed by stream and weather in making quarry chert into gravel chert would permit only the fittest to survive. Very little chert of the decomposing kind could reach and remain in a stream long enough to become iron impregnated. Tarr (by personal communication) suggests an internal strain on the chert nodule produced by unequal desiccation and shrinkage of the exterior portions. Such a condition is possible, though it should be found similarly in more opaline masses. The few such samples observed by the author have proved to be sound.

In conclusion it must be stated that many cherts are not unsound or unstable. The two factors which seem to contribute most to the instability of certain cherts are the microscopic irregularities of texture and the presence of firmly imbedded foreign crystals, such as pyrite, with their different physical properties.

Deterioration of Gypsum

CALCINED GYPSUM from certain localities has been found to deteriorate upon aging, as is evidenced by poorer working qualities after a storage period of some months. An investigation of the factors which influence the deterioration of calcined gypsum has been in progress for some time at the U. S. Bureau of Standards. Since all plasters do not exhibit deterioration, it may be assumed that the deterioration is caused by variations either in the raw material or in the method of manufacture. The investigation thus far has been confined to a study of the effects of various impurities on the stability of the plasters.

Calcined gypsum contains approximately 6.2% water of crystallization, and in the presence of moisture tends to combine with it to form the hydrate, containing approximately 20.9% water of crystallization. Therefore the moisture content of the mixture was used as a measure to show the deterioration caused by the various impurities. The moisture content was determined immediately after mixing and also at intervals for the period of 18 months. At the end of this period it was found that the moisture content of the unadulterated calcined gypsum varied from 6.3% to 6.7%. The majority of the mixtures also had a moisture content within these limits, or but slightly higher. However, in a few cases, notably those where chlorides, nitrates, and iodides were present, the mixtures were extremely lumpy and almost set, the moisture content varying from 10% to 19%. It was found that the salts which caused this deterioration were soluble and some were hygroscopic.

Since all of the salts thus far found to accelerate deterioration are more soluble than gypsum, it appears that a large part of the deterioration due to impurities may be eliminated by the simple expedient of washing the ground rock before calcination.—*Technical News Bulletin* of the U. S. Bureau of Standards.

New Gravel Plant in Northwest Ohio

Wapak Sand and Gravel Co., Wapakoneta, Ohio, Opens Modern Plant on Site of Former Plant Which Burned Down

ONE of the newest sand plants in the mid-west has just been placed in operation at Wapakoneta in the northwest part of Ohio. This in the operation of the Wapak Sand and Gravel Co. which began production on March 20 with a grand opening celebration sponsored by the company and by the Lewis and Copeland Construction Co., of which it is a subsidiary.

The new plant, which has a capacity of between 500 and 600 tons daily, is not the first operation on this site, as the pit was first operated about nine years ago. The original plant was destroyed in the fall of 1928, and operations were commenced on the opposite side of the pit in a new concrete plant which had just been completed. Unfortunately after five days of operation this plant was badly gutted by fire on November 21. The concrete foundations and bins remained apparently undamaged, but all the superstructure and equipment, including the electric motors, were destroyed or rendered unfit for use. Upon the same foundations the new screen house has been placed and new equipment has been installed since last November, and the plant is now operating smoothly and satisfactorily.

The plant is situated on a tract of 45 acres. Test holes have shown the deposit of good gravel over this area to be at least 100 ft. thick, but operations are still at a comparatively shallow depth. The pit which supplied the old plant is filled with water and one end is now used as a swimming beach for the town people of Wapakoneta. The new plant will eventually take sand from the other end of this same large pit, but at present the material is being taken from a cut which will in time reach to the end of the submerged pit. Tracks follow the steam shovel through the cut and the final arrangement will be to have a gasoline shovel with a 60-ft. boom for a dragline loading to cars on this track from the wet pit. A unit with a 1½-yd. bucket will be used.

An Erie shovel with a ½-yd. bucket is making the cut which supplies the present material to the plant. When the dragline is in operation, this shovel will be used for stripping. Water for the shovel is obtained from the wet pit by means of a Myers pump driven by an Associated Manufacturers Co. gasoline engine. The shovel loads to two standard-gage Western Wheeled Scraper Co. dump cars. These are drawn to the plant by a 5-ton Plymouth gasoline locomotive, one car being dumped at the crusher while the other is being loaded.

Crushing House

The locomotive delivers the cars to the foot of the steep incline just outside of the crusher house, and there they are attached to a hoisting cable and pulled up to the crusher. At the foot of the incline, a siding, or run-around, permits the locomotive leaving one car and picking up the waiting car on the other track. The cars are drawn up the incline by a single-drum hoist operated by 10-hp. Western Electric motor.

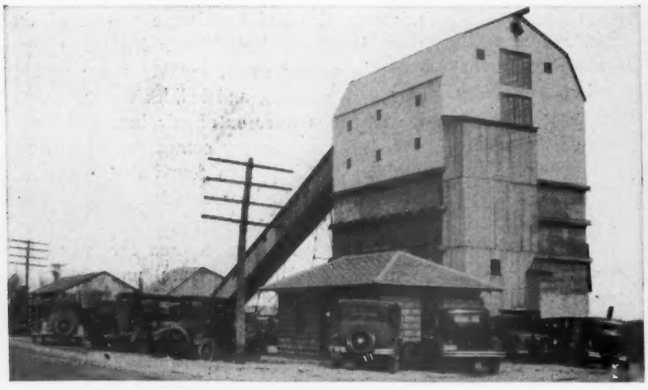
The cars dump to a sloping grizzly of standard railroad rails, which permits the small material to drop through to a hopper below, but sends the oversize to a No. 5 Gates gyratory crusher. A feeder at the bottom of the hopper maintains an even supply of material on the long 24-in. belt conveyor which takes the material from the crushing house to the screen house. The discharge from the gyratory crusher is also deposited on this belt. Two men are generally employed in the crushing house to dump the cars, keep the material moving down the grizzly and watch the crusher.

The belt conveyor to the screening plant is entirely enclosed. It is a Barber-Greene unit, operated by a 10-hp. General-Electric motor. The material from the belt is deposited directly in a revolving screen on the top floor of the screening plant.

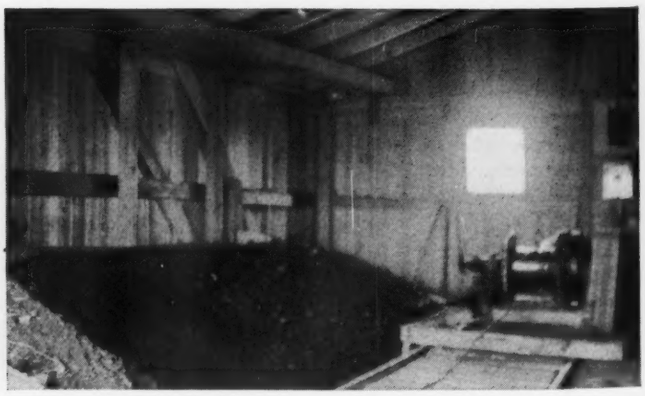
The screen house is a fireproof structure of steel framework covered with corrugated sheet metal siding. It stands three floors high above the concrete bins, and is finished with a gambrel roof. Thus this plant has all of its equipment sheltered from the weather, making it exceptional among sand and gravel plants. The screen house measures 34x40 ft., and this furnishes ample room for the equipment contained.

The revolving screen to which the 24-in. conveyor belt delivers its material is a 48-in. by 14-ft. Telsmith unit, manufactured by the Smith Engineering Works of Milwaukee, Wis. Its first section is a blind scrubber section, and its second half has 2-in., round, punched holes and is equipped with a jacket. The motor for this screen, like the motor for the 24-in. belt conveyor, is mounted on a platform directly above the screen and close up to the roof of the building, thus assisting in keeping the floor space clear. The motors are readily accessible by means of a short ladder. Both the screen and the conveyor are driven by belts.

Water for washing the material is pumped from the old pit by means of a Worthington centrifugal pump. This is located in a small pump house, built of concrete blocks, at the edge of the pit. A 15-hp. General-Electric ball-bearing motor furnishes the power.



The new plant of the Wapak company as seen from the Dixie highway. The building in front is the office



The hoist for raising cars to the crushing house, with the grizzly to which the cars dump shown at the left

A general view of the Wapak plant showing the enclosed conveyor from the crushing house, at the right, to the screen house

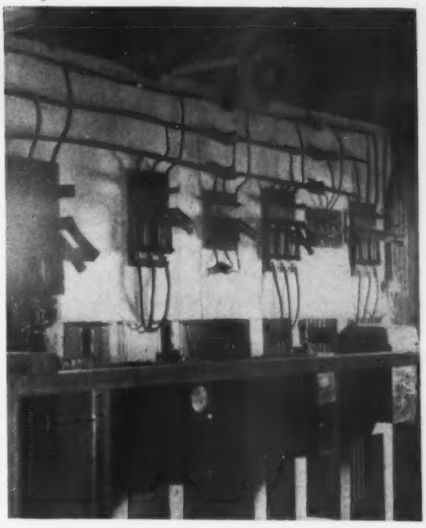
On the floor below the revolving screen is a single vibrating screen furnished by the Simplicity Engineering Co. of Durand, Mich. This screen receives the finer material which passes through the jacket of the revolving screen. The oversize from the jacket—that is, the gravel from ½-in. to 1¾-in.—is carried directly to one of the bins below by means of wooden chutes. And, finally, the rejects from the main screen, which are 2 in. and larger in size, are chuted to a square hopper on the middle floor, and from there fed to a Symons cone crusher, which is on the lowest floor of the screen house, directly above the bins. The cone crusher reduces the material to ¾-in. and smaller, and discharges it to the bin directly beneath. The company chose this style of crusher because of the uniform crushing obtainable with little oversize and it reports that the results have been entirely satisfactory. A 50-hp. General-Electric motor drives the crusher.

On the middle floor of the screen house is a well-laid-out, general switchboard controlling the electric operations for this part of the plant. The concentrating of the switches at one point in this way is another indication of the well-planned development of this plant. The switchboard is protected by a wooden guard rail.

The Simplicity vibrating screen receives the gravel from ½-in. down and rejects the ¼-in. to ½-in. material to one of the bins by means of chutes. The smaller stone passes to two Telsmith sand settling tanks which deliver their retained sand to the bins below. The tanks which were installed at first were No. 5, but the company changed to No. 7 tanks shortly after operations started with the idea of increasing the capacity. The capacity of the two tanks now in use is 450 tons daily. The waste water is carried off and discharged to a drain outside of the plant.

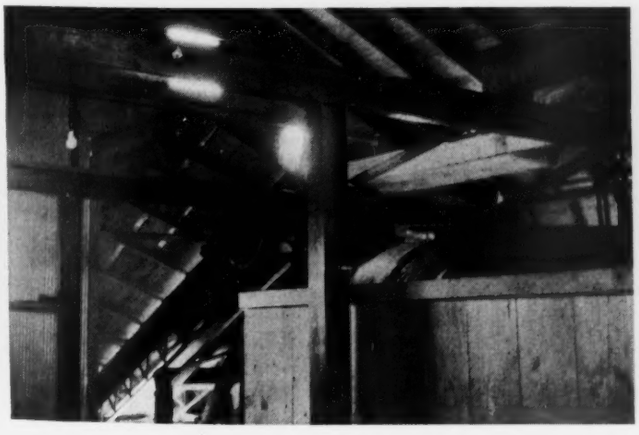
The chutes to the six bins are so arranged that some interchanging and combining of the various sizes is possible. The screening equipment described above provides four main sizes—½-in. to 1¾-in. for concrete aggregate, ¾-in. down to dust for gravel road surfacing, ¼-in. to ½-in. for building purposes and sand 3/16-in. down for various uses. These sizes can be combined in the bins as desired.

The concrete bins at the Wapak plant are in two rows of three each. Each pair of bins has a truck driveway running across underneath, but there is no railroad loading at this plant. There is a loading gate beneath each bin, and every bin also has an inclined loading chute at the inside edge of the bin, so that the material from each pair of bins can be combined as it is loaded by using the two chutes. Heavy wooden doors, which are raised vertically, have been installed at both ends of each truck driveway to protect the plant from the weather and from irresponsible or dishonest people. These doors are counterweighted to provide easy operation.

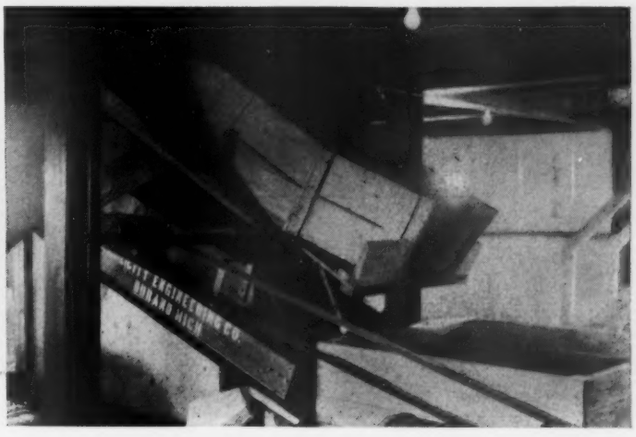


General switchboard in the screen house

Much of the output of this plant goes to state and county road work and for this work most of the material is delivered directly by truck. The Wapak company maintains loading yards at Wapakoneta, less than a mile away, for shipment of its material by rail when that is necessary. Here it ships over the Baltimore and Ohio railroad and the New York Central lines, using two loaders made by the Columbus Conveyor Co. of Columbus, Ohio, to fill the cars from the



Conveyor from the primary crusher depositing material in the rotary scalping screen



Vibrating sizing screen on the middle floor. The chute above and hopper at the right are for the cone crusher

storage piles. The company also maintains a yard adjacent to the Western Ohio electric line, and employs a Haiss loader at this point. Since the plant is situated directly upon the paved Dixie highway, the trucking of its output is simple.

The company owns three small Noble trucks of 1½-yd. capacity for small job hauling. It also has a continuous lease on five 2½-ton Garford trucks, manufactured at Lima, Ohio. During the busy season it also operates from 10 to 12 trucks of various makes but usually with 2½-ton capacities.

Beside the crusher house and the screening plant, there are also two other buildings on the property. One uncompleted structure will be used for a workshop and store room, and also as a place to house the locomotive and pit cars when they are not in use. The other building is the plant office set in front of the plant and near to the Dixie highway. This is a substantially built house of concrete block, and is equipped with scales for weighing the trucks as they pass.

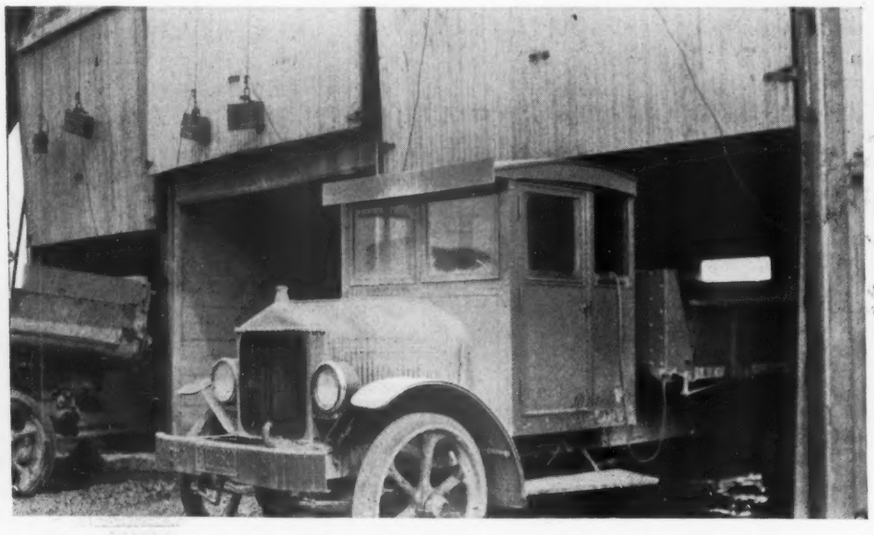
Plant Carefully Designed

Throughout this plant one notices the apparent attention to detail that has been made. While this is not a large plant in point of tonnage, it has been engineered carefully and is a credit to the company. A fully-enclosed, fireproof plant such as this is provides a possibility for operation when other plants must close down because of weather conditions, and certainly assures a longer life for its equipment when thus protected. This plant also can increase its output when the deposit now being worked is opened up to the large pit, and when the minor troubles attendant on starting out have been smoothed over.

The president of the Wapak Sand and Gravel Co., E. C. Lewis, of Lima, Ohio, is also president of the Lewis and Copeland Construction Co. The latter company owns and operates the Wapak company as an adjunct to its contracting and building supply business which is centered in Lima about 10 miles away. The Lewis and Copeland company also operates another gravel plant at St. Johns, Ohio, and a stone quarry at East Liberty. Since Lima is a manufacturing community of more than 60,000, the Lewis and Copeland company has an excellent business field for both of its lines of work.

Like Mr. Lewis, the other officers of the two companies are the same. J. A. Copeland of Lima is vice-president of both concerns, and W. P. Greer is secretary and treasurer of the two companies. H. Y. Miller is superintendent of the plant at Wapak.

The public beach in the old sand pit as seen from near the present plant. The remains of the original plant are seen on the opposite shore



Loading to trucks at the Wapak plant. The vertical counterweighted doors are shown above

Asbestos Treatment

INTERESTING EXPERIMENTS and departures from older methods of separating the asbestos fiber from enclosing matrix or gangue have been in progress for over a year in the Hardinge Co.'s laboratory at York, Penn., and also in its air separating mills installed at the Columbia University laboratory in New York City.

Similar tests have been made at the Department of Mines, Ottawa, Canada, all tending to the same end, i.e., the obtaining of as long a fiber as possible. More detailed data will be given as soon as further experiments confirm those already made by crushing in both ball and rod mills.

The method utilizes air flotation in the same manner that it is used in crushing coal and ceramic materials. The conical-ended, rod mill adapts itself particularly to this separation owing to the increased acceleration of air through the cone and consequent ability to lift the longer fiber while the crushed rock or gangue is being separated at the outlet. This system will, if successful, displace the older and more complicated methods of separating the fiber from the asbestos rock as now employed extensively.

The bin construction and the pairs of mixing chutes are well shown in this view looking across the truck driveways beneath the bins

Editorial Review of Recent American Concrete Institute Proceedings

Significance of Trends in Concrete Construction Industry to Material Producers

By Edmund Shaw
Contributing Editor, Rock Products

THE MEETINGS of the American Concrete Institute mark the progress of concrete in the United States, but that progress is not always in the same direction. The papers at the 1928 meeting laid emphasis on the characteristics of concrete produced by variations in the cement, such as workability, plasticity and volume change. This year the emphasis is on aggregates and their use. And rightly so, for as the study of concrete progresses it becomes clearer that aggregates are something more than the mere fillers of space that the name implies, and that they have other important characteristics than voids and grading; characteristics which are taken account of in the newer methods of designing mixes.

Every maker of cement, lime and gypsum ought to be more interested in aggregates than he has shown himself to be in the past, for aggregates are used with all these materials, and aggregates enter deeply into his problems of production and selling. As the manager of one of the largest Eastern cement plants once said to the writer: "The real problem of the cement manufacturer today is neither how to make nor sell his cement; it is how to get it used properly and with the right aggregates."

Aggregate Purchase Specifications

So the report of Committee E-5 proposing a purchase specification for aggregates is of the highest importance to the whole rock products industry. Few people will recognize what a job it was to draw these simple specifications. The writer, who served on the committee for a short time, thought at first that no specification could ever be drawn that could be filled by producers throughout the country. He had familiarized himself fairly well with the situation in his visits to plants in all sections and learning what he could of aggregate material resources and the conditions under which aggregates were used. Obviously climate had a lot to do with the matter, for aggregates that would be perfectly serviceable in the frostless parts of Florida, California and Texas would not do for the northern boundry line, especially for the region just south of the Great Lakes, where the climate is said to be hardest on concrete. And why should specifications be drawn to admit the soft limestones of some of the prairie states and then applied to sections like New York and Ohio, where excellent limestones and hard glacial gravels are found in abundance?

The committee kept on, however, and by elimination got down to a few fundamental characteristics which all aggregates must have, and put these into the specifications. Local changes, especially in the way of making the specifications more rigid, are advised, and tests are provided for those aggregates which comply with other requirements than those of grading. The producer who is in a locality where good rock and gravel are abundant will probably say that the specifications are too loose and would like them tighter to keep pit run and other inferior materials off the market. And the producer who is in a locality where really good aggregate deposits are scarce may complain that they are so tight as to be impossible to fill. But the disinterested person who knows the field will say that the committee has done a good job.

The specifications need some additions in the way of footnotes to bring them up to date. For example, beidellite in limestones has been responsible for so much disintegrated concrete (examples of which were given in discussing R. B. Young's paper) that stone containing it should be barred altogether. Regal's work on the bad effect of chert in Missouri highways and E. C. Lord's paper on the effect of weathered feldspar in sands show that the use of aggregates containing these materials should be limited to certain kinds of concrete. And the abrasion test described in D. O. Woolfe's recent paper in *Public Roads* seems to include a test for resistance to freezing as well as set up a criterion for the hardness and durability of the grains, and such a test might well be included.

Perhaps the most conspicuous weakness of the specifications is that of not defining what local bodies are competent to make the local changes that are suggested. State highway boards might be included and such engineering societies as that of Western Pennsylvania and the Detroit Engineering Society, which have already done good work in preparing local specifications. It is to be hoped that future meetings of the committee will consider these and other things which the specifications seem to the writer to lack.

Confusion from Many Specifications

It is full time that we had a national aggregate specification if only to use it as a basis for local specifications, for the confusion we now have is ridiculous. This was well brought out in a paper by L. E. Williams, "The Confusion of Specifications for Aggregate." Mr. Williams is engineer for a producing company and he shows the impossibility of filling all the specifications of the Detroit market. One of his tables gives the grading of five sands, fineness modulus from 2.86 to 3.21, any one of which would do for all concrete work except some special finishing jobs. Yet there is not one of them but what would be rejected by some and accepted by others of the paving specifications used in and around Detroit, all for practically the same work.

He says that two specifications for fine aggregate and three for coarse, with perhaps a fourth for very special work, should be enough. The engineers and architects may require a somewhat greater variety than this, but even so there is no reason for the multiplicity of specifications which not only Detroit but every large city has. Chicago, if I remember rightly, has 32 specifications for crushed stone alone. Producers, as well as the whims of architects and engineers, are responsible for this state of affairs, for many of them oppose simplification and standardization of specifications for fear they will lose some special customer. The efforts of the aggregate and standardization of sizes committees of the National Crushed Stone and National Sand and Gravel Associations have not been conspicuously successful on that account. It seems a short-sighted view for producers to take.

Aggregates on the Job

There are two or three papers that deal with aggregate on the job, the shape in which it is received, the way it is handled and so on. One that is filled with hints to

producers is the paper of A. S. Douglas and J. S. Nelles giving their experience as engineers for the Detroit-Edison Co. In the list of aggregates they mention is one that is unusual, a "balanced aggregate," a mixture of crushed limestone and gravel. It was reported to be unsatisfactory because the limestone ran too much to one size and because the mixing was poor. Proper preparation would remedy both these defects. The use of stone and gravel mixtures is unusual but one sees no reason why they could not be advantageously used in some localities, for example in localities where gravel is cheap but deficient in the coarser sizes and where crushed stone producers would prefer to sell the larger sizes rather than to recrush them.

The engineers said that all the aggregates they received were not uniform in grading and that they were troubled with segregation of sizes. Uniformity was secured for a time from one producer, but in the peak of the season only the regular plant run was shipped. The paper explains this by saying that most users are not so particular about uniformity of grading and the plant is run to supply the greatest market.

In other words the producer was willing to go as far as he could to comply with their wishes without losing money, and this is the attitude of most producers. Maintaining a uniform grading costs money and the producers who do it must get an extra price for their material. One producer in Iowa built up a good business by guaranteeing a constant fineness modulus, but he got above the market price of his competitors for it; and the contractors who bought it claim it saved them money. Maintaining uniformity often means not only extra supervision and inspection but throwing away part of the product or selling it at at low price. It would be well if the users of aggregate could understand this and then they could choose between the extra cost of uniformly graded aggregate and changing the mix for each shipment, as is often done, without any hard feelings on either side.

However, the use of separately sized aggregates, to be combined at the mixer, is increasing and this is claimed to do away with both ununiformity and segregation. The authors had to change over to separated aggregates in one case solely to avoid segregation. For mixed sizes they advise the use of swinging chutes in loading cars, which a great many producers already use. They also advise the mixing of sizes on a belt which is the practice in the better stone and gravel plants, as is the stockpiling in separate sizes which they strongly recommend.

The paper gives one unusual table, that which shows the variation in the cost of concrete due to the bulking of aggregates. The bulking varied from 10% to 33% and the paper says it would be advisable to stock up on dry days and avoid deliveries on wet days. It would be equally advisable for the producer to crowd his deliveries on wet days and to hold back on dry days; both statements are excellent arguments for buying and selling aggregates only by weight. So too is the statement that "the actual amount of material delivered (for a 5- or 6-yd. load) varied to a surprising extent."

How Uniform Grading Was Maintained on One Large Job

That it is possible to maintain uniform grading on large shipments is shown by L. G. Lenhardt's paper describing the concrete lining of the 11-mile tunnels for Detroit's water supply. Inspection began where it should for such important jobs, at the pit. Care was taken to unload the cars with a clamshell that was dumped while swinging, for this gave the least segregation. In loading from the storage yard care was taken to load from a uniform cross section of the piles, and the material was placed in the job bins so as to avoid segregation. Filling these with a clamshell gave less segregation than loading with a bucket elevator, but leveling by hand as the bin was filled by the elevator improved matters. Before leveling was adopted the fineness modulus variation in the discharge was 0.70 but after leveling it was brought to 0.30. A swinging spout on the elevator would probably give as good a result.

The aggregate for this job was bought under the specifications recommended by the concrete committee of the Detroit Engineering Society, which the paper says are a long way ahead of those previously in vogue. By these sand is defined to be that passing No. 4 sieve and retained on 100-mesh. The fineness modulus is fixed at 3.00 with an upper limit of 3.25 and a lower limit of 2.75. Coarse aggregate is that passing a 2-in. square opening and retained on No. 4, the fineness modulus to be 7.25 with a lower limit of 6.90 and an upper limit of 7.60. A grading curve is attached and this shows that a 5% tolerance above and below the maxima and minima is allowed. It would be difficult to find fault with so simple and reasonable a method of specifying sizing and grading.

Aggregates for Highway Concrete

The part played by aggregates in paving is the feature of F. H. Jackson's paper in the symposium on concrete for various uses. He brings out the importance of considering other characteristics of aggregates than the voids and grading by saying that tensile and flexural strength, which are more important in paving, are affected more by the physical character of the aggregates than compressive strength. Also that, "we are not at all sure that other factors than the water-cement ratio are fully as important in controlling these qualities" (tensile and flexural strength).

Soundness he considers especially important in paving aggregates, and he says that "shale, certain varieties of flint, etc." should be avoided, but an aggregate that passes the sodium sulphate test should prove satisfactory. The purchase specifications committee, of which Mr. Jackson is chairman, suggested passing this test (which some consider to be so severe as to be unfair), but accepted the passing of a freezing and thawing test as an alternative. Scaling as well as deeped disintegration is ascribed to unsound aggregates although the paper says it is usually due to poor workmanship.

Perhaps the most interesting part of Mr. Jackson's paper is that in which he refers to the tests now being conducted by the Bureau of Public Roads on various types of aggregates, 17 in all, including slags and various types of limestone, trap and gravel. The detailed result of these tests is awaited somewhat eagerly (and perhaps anxiously) by the aggregate industry. Meanwhile it is interesting to know that for a given cement content and water-cement ratio, the modulus of rupture may vary from 530 lb. to 650 lb. at 28 days, depending on the kind of aggregate used, according to these tests.

Of the highest importance to producers are the recommendations of the Bureau of Public Roads given in Mr. Jackson's paper. But these were included in the report of the convention in the March 2 issue of Rock Products, and they seem to call for no comment further than to note that they seem to point to the use of coarser aggregate in highway concrete, and this is going to be hard to find in some localities where river gravel is about the only available local material.

Papers on Concrete Mix Design

Every Institute meeting brings out some excellent papers on the design of concrete mixes, for the subject is a live and progressive one. This 1929 meeting was no exception, for there were three or four important papers concerning design. The subject is one with which aggregate producers have to keep in touch as nothing more closely concerns the preparation and sale of their product.

The notable thing about the papers on design is that all consider the water-cement ratio to be the proper basis for design, although one paper says it is only a good working rule and not a law. All these papers were abstracted in the March 2 issue, but it is of interest to analyze and compare them with other studies of the subject. The simplest of them is that of R. E. Robb, who who worked out a method to teach a class that contained men who had only an elementary training in mathematics. It is a simple trial method with ways of checking the water-cement ratio and the fineness modulus of the aggregates. One feature of the paper is the study of aggregates from all parts of the country to determine the correspondence between total moisture and free water in damp aggregates. The plot shows variations in different aggregates, but a correspondence which is held to be close enough so that if one knows the total moisture he can assume the free water from the plot.

Determining moisture in aggregates is a most important matter in designing by the water-cement ratio and it has been investigated by William R. Johnson, of the Portland Cement Association laboratory, who gives his results in a paper. Only two meth-

ods, drying in an oven and burning with denatured alcohol, gave more than a rough approximation to the true moisture content. This somewhat surprised me, and it probably will others who also have supposed such methods as the use of the A. S. T. M. flask to be sufficiently correct. The difficulty with this and the other displacement method and the salt hydrometer method seems to be that the readings cannot be made closely enough, and this suggests that the apparatus may be improved. In R. E. Robb's paper, just referred to, is an improvement on the ordinary displacement apparatus which might be found to be more correct. However, it is difficult to see where there is much advantage in any of these methods over the very simple one of burning off the moisture with alcohol, which requires no special apparatus and which can be performed in a short enough time for all practical purposes.

In the absolute basis of proportioning concrete described by Joseph A. Kitts, who has used it on many important jobs in California, uniformity in grading is secured by combining the aggregates according to the Kitts-Peugh equation, which takes into account requirements of maximum and minimum size coarseness and uniformity. To do this, the combination of the available aggregates is made according to a "coarseness modulus" which is found in the same way as the fineness modulus except that the screens are taken in reverse order, the finest first. The remainder of the calculation is, as the paper says, simple arithmetic and physics. Accompanying the paper are two interesting charts giving an analysis of concretes from the economic and from laboratory standpoints. This method of close control is admitted to be more expensive than the ordinary methods, but the paper shows that it pays well, especially on large jobs.

Admitting this and the correctness of the method it is difficult to see what advantages it has over the method of Stanton Walker, given in a National Sand and Gravel Association *Bulletin* about two years ago, which was also based on absolute volumes. It is also difficult to see wherein it is better to combine aggregates by the "coarseness modulus" than by the fineness modulus if the mix is to be adjusted as the aggregate varies.

Prof. Herbert J. Gilkey's paper on design is in one sense a continuation of his papers of the past two meetings, but in this he reduces everything to tables so that field and laboratory results can be readily compared. The corresponding strengths, according to Abram's equation, are included. The paper is almost wholly made up of charts and tables, which are of more interest to the concrete engineer than to the producers of cement and aggregates.

A paper on design which the author admits will probably cause considerable discussion, is that of T. C. Powers describing the studies of concrete for the Bull Run (Oregon) dam. It is really an examination of the application of the water-cement ratio to design. Mr. Powers finds that the strength-water-cement ratio relationship is contingent on three variables and the lack of uniform relationship of these variables is responsible for the "scatter" observed when the results of tests are plotted. He also says that it is a fallacy to speak of the strength-water-cement relationship as a law, but confirms its use as a good working rule, which is all that the ordinary concrete worker cares for.

Admixtures

To many practical workers the interesting feature of the paper just referred to will be the experience with admixtures. Diatomaceous earth and other fine inert materials were found to bring about a different relationship between water-cement ratios and strength, increasing the strength without increasing the water-cement ratio or the cement paste content, as well as decreasing permeability. The reason given is not the usual one of absorption of the water by the admixture. It is that the presence of diatomaceous earth keeps the cement from settling away from the underside of the aggregate so that top and bottom sides of the aggregate are well bonded. Reasons for this conclusion are given in some detail and references are made to photographs by Prof. Gilkey published in *Engineering News-Record* February 10, 1927, which show the effect.

In Lenhardt's paper on the tunnel lining, mentioned above, admixtures were also discussed. In this paper there is a curve of strengths for various slumps of both plain concrete and concrete with diatomaceous earth. The drop in strength as the slump increases is much less with the diatomaceous earth concrete than with the plain concrete (from 3900 lb. to 3700 lb. as against 4100 lb. to 3600 lb. for slumps from 2 in. to 8 in.).

Nevertheless Douglas and Nelles in their paper on their experience with the Detroit-Edison Co. say positively that portland cement itself is the best admixture and that "we are of the opinion that the value of other admixtures in good concrete is much over-rated." Which leaves the matter still open for discussion and suggests that still more investigation on both the theory and practice of using admixtures is needed.

New Mississippi River Gravel Tow Boat

THE CENTRAL Sand and Gravel Co. of Memphis, Tenn., will shortly have in service one of the most powerful and modern steel tow boats on the Mississippi. The boat, to be named the *W. W. Fischer* in honor of the president of the company and well-known Memphis citizen, is now under construction at Nashville. The *W. W. Fischer* is on the twin screw type, 120 ft. long, 26 ft. beam and 8 ft. draft. She will be powered with two Diesel engines of 360 hp. each. She is being built on the ways of the Nashville Bridge Co.

Resumé of Specifications for Gravel and Sand

BULLETIN 3 of the National Sand and Gravel Association, which has been recently issued, is called "Representative Specifications for Different Uses of Sand and Gravel." It is a thoroughly practical book and one that every producer should possess. The ordinary producer often fails to secure a market for a part of his product because he is ignorant of what is wanted for more than one or two uses of sand and gravel; if he learns of other uses he does not know what specifications he must fill in order to sell his product. This bulletin will tell him and it will also give him a comparative view of the specifications under which he already works.

The authors, Stanton Walker and C. E. Proudley, director and assistant director of the engineering and research division of the association, expressly state that the specifications are reprinted without any of them being recommended. But wherever they exist, the specifications of an authoritative nature are given as fully as possible. Thus the specifications of the American Society for Testing Materials, the Joint Committee on Concrete, the Federal Specification Board and the Asphalt Association are printed as fully as space will permit. The specifications of the state highway departments and some others are arranged in a tabulated form which allows the requirements for any state to be found with very little trouble.

The headings for the sections of the Bulletin are: "Specifications for Concrete Sand; Specifications for Gravel for Concrete; Sand and Gravel for Bituminous Construction; Miscellaneous Uses of Sand in Highway Construction; Sand for Use in Building Construction; Requirements for Washed Gravel Ballast; and Sand and Gravel for Miscellaneous Uses. The last heading sounds as if it were unimportant but it is one of the most important in the book to the producer who is looking for information. In it are found the requirements for filter sand, filter gravel, foundry sands, glass sand, sands for polishing, grinding and other abrasive uses and engine sand. The chemical as well as physical characteristics are given.

The authors and the association have done a very valuable piece of work in preparing this bulletin. It is valuable not only to the sand and gravel field but to the entire rock products industry and the users of rock products. The work required to compile such a listing of specifications must have been great, especially where they had to be checked with original sources which had to be done with the state and some other specifications. The ground that had to be covered may be appreciated when one recollects that sand and gravel in some form is used in practically every industry in the United States. Copies of the bulletin referred to may be obtained by interested persons by application to the association.

Heat Transfer in the Rotary Kiln Burning Portland Cement Clinker*

By Robert D. Pike
Pike and West, Consulting Engineers, Emeryville, Calif.

THE PURPOSE of this paper is to examine into the heat-transfer relations existing in a rotary kiln burning portland cement clinker and to derive therefrom conclusions which are of importance in designing rotary kilns for greater fuel economy. It has been shown that an ideal apparatus would consume 405,000 B.t.u. per barrel and that actual rotary kilns consume over three times this amount; also that the general nature of the process is such as to lead one to expect that high fuel economy, combined with high output, should be obtainable. But to be able to proceed with design of such apparatus one must first understand the heat-transfer relations existing in present-day kilns. Through this paper it has been necessary to refer to many of the data of the previous paper (ROCK PRODUCTS, Feb. 2, 1929.).

Certain important relations result from the fact that the heating processes in a rotary kiln are carried out in series. The flame first accomplishes the clinkering, and the gases of combustion then pass in series into the calcining zone, where they accomplish calcining. In a certain sense calcining is accomplished with waste heat from the clinkering zone. We are interested primarily in the temperature relations occurring in the heating gases in passing serially through the kiln.

Fig. 1 shows diagrammatically two-series heating processes such as, for example, clinkering and calcining. Hot gas or flame enters P_1 from the left at temperature T_1, and leaves on right at temperature T_2. The same gas immediately enters P_2 from left at temperature T_2, and leaves on right at temperature T'_3. G' is the weight of gases of combustion flowing per pound of material treated. H_1 is the total heat to be transferred per pound of material for process P_1, including the addition of sensible heat to the material, chemical heat, and losses to the outside. H_2 is the same for process P_2. Of course, P_1 and P_2 can be any sort of thermal processes, but in this analysis P_1 is taken as the clinkering process and the P_2 as the calcining process, and it is immediately evident that the condition shown in Fig. 1 represents the condition occurring in a rotary kiln, where they first effect the process of clinkering and then, passing on, next accomplish the process of calcining.

The heat entering P_1 from left is $G'(T_1 - t)s$ and heat leaving from right is $G_1(T_2 - t)s$. Then

$$H_1 = G'(T_1 - T_2)s \qquad (1)$$

$$G' = \frac{H_1}{(T_1 - T_2)s} \qquad (2)$$

The heat entering on left of P_2 is the same as the heat leaving right of P_1, and heat leaving right of P_2 is $G'(T'_3 - t)s$.

$$H_2 = G'(T_2 - T'_3)s \qquad (3)$$

$$G' = \frac{H_2}{(T_2 - T'_3)s} \qquad (4)$$

But G' is the same in P_1 and P_2; therefore,

$$\frac{H_1}{(T_1 - T_2)s} = \frac{H_2}{(T_2 - T'_3)s} \qquad (5)$$

or

$$\frac{H_1}{H_2} = \frac{T_1 - T_2}{T_2 - T'_3} \qquad (5')$$

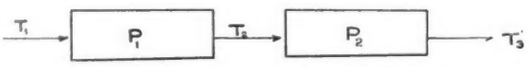


Fig. 1. Diagram of two-series heating processes

But H_1/H_2 is a constant for a given process in a given rotary kiln at a given rate of working.

$$\frac{T_1 - T_2}{T_2 - T'_3} = K \qquad (6)$$

Equation 6 involves the assumption that s, the mean specific heat of the gases, is constant over the temperature range $T_1 - T'_3$, which, of course, is not strictly true but leads to no serious error.

To apply these equations numerically, it is necessary to establish a reasonable division of the losses to the outside as between the respective zones of the kiln. To do this we will employ the data of kiln surface temperatures given in the previous paper coupled with data on the length of the different zones of a 125-ft. kiln burning portland cement clinker, taken from Rankin.†

The length of the zones and their mean surface temperatures are as follows:

	Feet	Deg. F.
Cooling zone at lower end of kiln	10	381
Clinkering zone	15	385
Calcining zone	55	263
Heating and dehydrating zone	45	179
	125	

The losses are:

	Per cent of total	B.t.u. per lb. clinker
Cooling zone	13.05	56.4
Clinkering zone	19.85	85.8
Calcining zone	45.30	196
Heating zone	21.80	94.2
	100.00	432.4

The theoretical temperature of dissociation of calcium carbonate is 1446 deg. F. under the average existing conditions, and in accordance with the writer's observations on the performance of a large multiple-hearth calciner, in which the progress of calcination could be observed from hearth to hearth, calcining does actually begin at this temperature and is finished at about 1750 deg. F. The mean specific heat of the material over the range in question is about 0.25, and of the carbon dioxide, which is assumed to be heated over one-half the range, about 0.287. Therefore,

Sensible heat imparted to material B.t.u. per pound clinker, 304×0.25	76
Same for CO_2, $152 \times 0.552 \times 0.287$	24
Total	100

Then H_2 = heat for calcining $CaCO_3$ + sensible heat + radiation loss = 1196 B.t.u.

In the clinkering zone the material is heated from 1750 deg. to 2700 deg. F.

Sensible heat added per pound, $950 \times 0.255 = 242$
Then $H_1 = 242 + 85.8 - 153 = 175$

$$K = \frac{H_1}{H_2} = \frac{175}{1196} = 0.146$$

This constant K is the approximate value for the observed kilns.

The lower 10 ft. of the kiln is a heater for the air. The clinker becomes cooled from 2700 to 2250 deg. F., giving up about 157 B.t.u. per pound. The radiation losses are about 56 B.t.u. per pound. Heat given to the air is 99 B.t.u. by each pound of clinker. Assume a surplus air of 15%. This gives 3.6 lb. of air per pound of clinker and the temperature of the air will therefore be raised by 110 deg. F., and will enter the clinkering zone at 170 deg. F. We next calculate the theoretical temperature of combustion with 15% surplus air at 170 deg. F. This calculation allows for no correction for radiation, and proceeds by the usual manner.

In Fig. 2 are plotted some calculated theoretical temperatures of combustion for the given oil fuel against temperature of air for combustion for various percentages of surplus air. The theoretical temperature of combustion for the observed kilns, with 15% surplus air, is calculated at 3895 deg. F., which is the T_1 of the above equations.

Equation 2 can be solved for T_2 using the following values: $G' = 3.83$, $T_1 = 3895$, $H_1 = 175$, $s = 0.30$; giving $T_2 = 3740$ deg. F. Then knowing T_1, T_2 and K, Equa-

*Reprinted from the March, 1929, issue of *Industrial and Engineering Chemistry* by special permission and courtesy of the publishers, the American Chemical Society.

†Rankin, *Concrete* (Mill Section), 21, 72 (1922).

tion 6 is used to solve for T'_3, giving $T'_3 = 2670$ deg. F.

It will be interesting to calculate from the above the temperature of the exit gases from the heating zone and compare this with the value of 1800 deg. F. used in the previous paper.

Gas of combustion at 2670 deg. F. leaving calcining zone per pound of clinker	3.83 lb.

These gases are from combustion only and are mixed with 0.552 lb. of carbon dioxide from calcination at the mean temperature of calcination, which has been taken as 1598 deg. F.

Total weight of gases leaving calcining zone per pound clinker	4.38 lb.
Temperature, T_3, resulting from mixing 3.83 lb. gas at 2670 deg. F. with 0.552 lb. CO_2 at 1598 deg. F.	2530 deg.F.
	B.t.u.
Heat required to raise 1.552 lb. raw mix from 100 to 1446 deg. F.(m.s.h., 0.264)	552
To calcine $MgCO_3$	26
Radiation losses from heating zone	94
To dehydrate clay	149
To evaporate water of raw mix	5
Total heat to be furnished by gas in heating zone	826
Temperature drop in 4.38 lb. of gas to supply this heat taking a m.s.h. of 0.28	674 deg. F.
Temperature of exit gases, 2530 deg.—674 deg. F.	1856 deg. F.

This is a satisfactory check with the figure 1800 deg. F., employed in the former paper, and the figure has been derived independently of that figure and in such a way as to give information about the temperature conditions existing within the kiln.

Heat Transfer Numbers

The number of heat units transferred per unit area of heating surface per hour per degree difference between the temperature of the material being heated and the temperature of the heating gas is known as the heat-transfer number, and is a number of fundamental importance in all heat-transfer calculations. Data on the value of this number in rotary kilns burning cement clinker seem to be lacking, but we have sufficient information at hand to calculate, at least approximately, the transfer numbers for the calcining and heating zones of rotary kilns observed by the writer. The transfer number h_c in the calcining zone is given as follows:

$$h_c = \frac{M \times 60 \times H_2 \times 2}{\pi d \times L_2 (T_2 + T_3 - 2T_r)} \quad (7)$$

In the observed kilns:

M = 127 lb per min.
H_2 = 1196 Bt.u. per pound (including losses to outside).
d = 5 ft.
L_2 = 55 ft.
T_2 = 3740 deg. F.
T_3 = 2530 deg. F.
T_r = 1598 deg. F. (av.)

Substituting these values:

h_c = 5.22 B.t.u. per sq. ft. per hr. per deg. F.

The number h_c is calculated, based upon the assumption that the surface to which heat is transferred is the inside face of a hollow cylinder having the diameter inside the brickwork of the kiln.

The following formula is much employed for calculating heat-transfer numbers for gases flowing through pipes, it being assumed that transfer of heat is by conduction and convection only.[1,2]

$$h_g = \frac{0.88\, V_m^{0.8} \times T^{0.5} \times S^{0.2} \times MC_p}{M^{0.5}} \quad (8)$$

in which

h_g = gas film transfer number, B.t.u. per sq. ft. per hr. per deg. F.
V_m = velocity in pound mols of gas per sq. ft. free area per sec.
M = average molecular weight of gases.
C_p = average specific heat at constant pressure.
T = arithmetic mean gas temperature, deg. F. abs.
S = surface factor in reciprocal feet.

In case of a circle

$$S = \frac{4}{\text{inside diameter in feet}}$$

In the case of the observed kilns,

$$V_m = \frac{4.06 \times 127}{60 \times 30 \times 25} = 0.0114$$

M = 30
C_p = 0.30

$$T = \frac{3660 + 2500}{2} = 3080$$

$$S = \frac{4}{6} = 0.67$$

Substituting values,

h_c (calcd.) = 2.06, compared with the value of 5.22 for the observed kilns.

Similarly, the heat transfer number h_h in the heating zone of the observed kilns is given as follows: (9)

$$h_h = \frac{M \times 60 \times H_3 \times 2}{\pi d L_3 (T_2 + T - 2T_m)}$$

The values are:

M = 127 lb clinker per min.
H_3 = 826 lb. B.t.u. given to material and to outside per lb. clinker
L_3 = 45 ft., length of heating zone
d = 6 ft.
T_2 = 2530 deg. F.
T = 1856 deg. F.
T_m = 773 deg. F.

Substituting the values in Equation 9, h_h = 5.23. The same value calculated from Equation 8 is 1.97.

These figures show very plainly that Equation 2, based upon the assumption of a transfer by convection and conduction only, does not give correct values for the heat-transfer number in the rotary kiln. The actual values are more than twice as much in both the calcining and heating zones. This discrepancy is, no doubt, due to radiation of heat from the gaseous molecules of carbon dioxide and water.

The radiation of heat from gases, under actual furnace conditions, has recently been investigated by Schack[3] and Lent and Thomas.[4] According to these data, in a tube of dimensions similar to those of the observed rotary kilns and with gases of a comparable composition, the radiation from the gases in the calcining zone should be of the order of 25,000 B.t.u. per sq. ft. per hour. The actual transfer is 8020 B.t.u. per sq. ft. per hour. Similarly, in the heating zone Shack's data would indicate a transfer of about 13,000 B.t.u. per sq. ft. per hour, as compared with an actual transfer of 7430 B.t.u. per sq. ft.

The figures for the rotary kiln show considerable discrepancies from those given by Schack and by Lent and Thomas. This might be expected because dust interferes with radiation in both zones and in the calcining zone, which shows the greatest discrepancy, both radiation and convection are interfered with by the evolution of carbon dioxide gas from the material. Evidently convection and conduction alone do not account for heat transfer in the calcining and heating zones of rotary kilns. The additional heat transfer is due to radiation from the carbon dioxide and the water constituents of the gas. Furthermore, according to Schack and others, the radiation from gases is greatly increased by increasing the depth of the gas which furnishes the radiation. From this last aspect of the law of heat radiation from gases, an important principle of furnace design immediately follows—that when gases are very hot or in flame, furnace volumes should be relatively large and gas velocities correspondingly small; but, on the other hand, as the gases cool down and convection and conduction become the principal means of heat transfer, furnace volumes should become smaller and gas velocities correspondingly greater. There appears, then, to be good justification for the principle of using an expanded lower section in a rotary kiln, but the actual advantage derived is small, because for mechanical reasons the expansion can only be small.

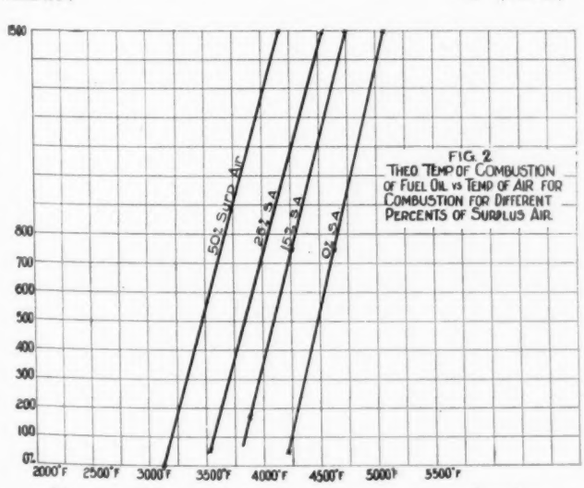


Fig. 2. Theoretical temperatures of combustion

[1]Walker, Lewis and McAdams, "Principles of Chemical Engineering," p. 149, McGraw-Hill Book Co.

[2]McAdams and Trost, "Heat Transfer by Conduction and Convection," M.I.T. Publications, *Serial* 77.

[3]Schack, *Z. Ver. deut. Ing.*, **58**, 1017 (1924); Anon., *Mech. Eng.*, **47**, 41 (1925).

[4]Anon., *Ibid.*, **47**, 43 (1925).

Discussion of Transfer Numbers

The heating gases, in passing through a rotary kiln, transfer their heat by means of conduction, convection, and radiation impartially to the bare brick walls and to the exposed material. All the heat transferred directly to the brick walls is, in turn, transferred to the material either by radiation or by conduction when the wall rotates beneath the material. It is therefore proper to consider the total heating surface within the kiln as the total surface swept by the gas, or what is almost the same thing, πdL.

A consideration of some of the factors which make up the numbers h_c and h_h shows them to be extremely complex. For example, the temperature level in the calcining zone is higher than in the heating zone, yet the transfer numbers in both zones are the same. No doubt evolution of relatively cold carbon dioxide from the calcining raw mix cuts down heat transfer by absorbing heat and carrying it away from the material. Dust in the gases throughout the length of the kiln also impedes heat transfer. Yet these factors defy numerical analysis. The transfer of heat to the brickwork, which in turn transfers heat to the material as the kiln rotates, results in cycles of heating and cooling of the brick work. The mean temperature of gases in the calcining zone is 3205 deg. F., and of the material 1598 deg. F. The approximation has been implicit in the above calculations that the temperature of the brickwork is the same as that of the material. Therefore,

Heat absorbed per hour per sq. ft. of brickwork (3205 — 1598) × 5.22	8360 B.t.u.
Suppose the kiln rotates at 1 r.p.m.; then the theoretical temperature rise per revolution of equivalent 1 in. depth of exposed brickwork	58 deg. F.

The actual temperature rise of the exposed brickwork will not be so high as the theoretical rise, because the brick surface will radiate heat to the colder material. When the brickwork passes beneath the material with a sort of sliding contact, the conditions for heat conductivity from brick to material are very good and the diffusivity of the brickwork will probably be the factor limiting heat transfer, whereas when the brickwork is exposed it seems safe to assume that the gas film resistance is the limiting factor. It is obvious that the temperature of the brickwork in passing beneath the material cannot be reduced to that of the material. On this account and because of the heating up of the exposed brickwork, its mean temperature will be somewhat higher than that of the nearby material. For this reason and because we have assumed a perimeter, πd, somewhat greater than the actual perimeter, the numerical values of both h_c and h_h are greater than the calculated values.

This discussion shows that variables other than those appearing in Equation 8 may have significant influence upon the heat-transfer numbers and hence upon the fuel economy. These variables are time of rotation of the kiln, sector covered by the material, and diffusivity of the material of the lining. The slope of kilns, the rate of revolution, and their diameter for a given throughput, in so far as it affects the load in the kiln and the physical properties of the lining, are all important subjects for quantitative study and estimation. Unfortunately, we have no data at this time which will permit even an approximate estimation of the effect of these variables upon heat transfer; and in estimating those variables which affect heat transfer it has been necessary, for the sake of simplicity of calculation, to ignore all except mass velocity of the gases, which enter the numerator of Equation 8 to the 0.8 power.

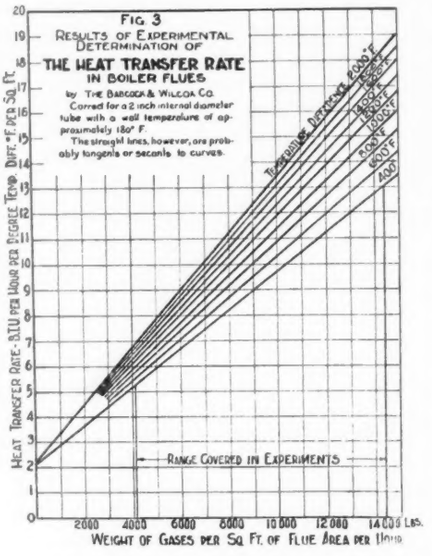


FIG. 3
RESULTS OF EXPERIMENTAL DETERMINATION OF
THE HEAT TRANSFER RATE IN BOILER FLUES
by THE BABCOCK & WILCOX CO.
Correct for a 2 inch internal diameter tube with a wall temperature of approximately 180° F.
The straight lines, however, are probably tangents or secants to curves.
TEMPERATURE DIFFERENCE, DEG. F.
1400°
1200°
1000°
800°
600°
400°
RANGE COVERED IN EXPERIMENTS
HEAT TRANSFER RATE - B.T.U. PER HOUR PER DEGREE TEMP. DIFF. °F. PER SQ. FT.
WEIGHT OF GASES PER SQ. FT. OF FLUE AREA PER HOUR
2000 4000 6000 8000 10 000 12 000 14 000 Lbs.

Fig. 3. Results of experimental determination of heat transfer rate in boiler flues

Haslam, Lovell, and Hunneman[5] have studied radiation from non-luminous flames. The results seem, in some particulars, contradictory to those of Schack[3] and Lent and Thomas,[4] but they may not be entirely comparable because, whereas Haslam and his associates dealt with actual flames, Schack and Lent and Thomas dealt with hot gases, presumably after flame phenomena had ceased. Nevertheless, in furnaces it would hardly be possible to distinguish between the effects of hot gases and of actual flames, and the fact that in practice flames are seldom non-luiminous, further complicates the matter. It seems evident that the phenomenon of heat transfer from flames and very hot gases in the relatively large volumes existing in furnaces is understood only very imperfectly, and it is entirely impossible, both on this account and because of the extreme complexity of the mathematical relations thus far developed, to set down any usable equation for the transfer number in terms of all the variables that affect it. If we are to proceed with the development of a method for analysis, we must first adopt some very broad and sweeping simplifying assumption in connection with the transfer number. The justification of such an assumption must be found in the development of usable formulas which make predictions found to be substantially in accord with known practice.

The conception of heat transfer in the actual combustion zones—i e., the clinkering zone of the rotary—is explained later. In the calcining and heating zones we proceed upon the assumption that as long as the mass velocity of the gases remains constant the heat-transfer number remains constant, with a value, as above set forth, of 5.22 B.t.u. per sq. ft. per hour per deg. F. difference between temperature of gas and that of the surface over which the gas sweeps, it being further assumed that this entire surface has the same temperature as that of the material under treatment.

It remains to assign an approximately correct rule of variation of the transfer number with the mass velocity. Equation 8 shows that, in so far as conduction and convection are concerned, $h \propto V^{0.8}m$, but whereas the actual transfer number is 5.22, the number derived from Equation 8 is 2.06 in the calcining zone and 1.97 in the heating zone, an average value of 2. A very interesting contribution to our knowledge of heat transfer in tubes is given in a booklet published by Babcock and Wilcox.[6] The principal results are summarized in Fig. 14, reproduced here in as Fig. 3. At zero mass velocity in 2-in. tubes, in which the effect of radiation would probably be very small, if not entirely negligible, the results show that the transfer number is about 2 for all temperatures. For each temperature the transfer number is a separate lineal function of the mass velocity, and is greater at higher temperatures. Fig. 3 would indicate a transfer number of approximately 4 in both the calcining zone and heating zone, if our rotary kiln were 2 in. instead of 72 in. in diameter. But Equation 8 shows that the transfer number varies as $S^{0.2}$, S being, for a flue with circular cross section, 4 divided by the inside diameter, in feet. S for a 2-in. tube is 24, and for a 72-in. tube, 0.67. Application of this factor to the Babcock and Wilcox transfer number gives

$$4 \times \frac{0.67^{0.2}}{24^{0.2}} = 1.96$$

a result in substantial accord with that obtained entirely from Equation 8.

Continuing the discussion of the effect of mass velocity upon heat-transfer number, we will assume that in both the calcining and heating zones

$$\frac{2}{5.22} \times 100 = 38.3\%$$

of the heat is transferred by conduction and convection and the balance, or 61.7%, by

[5] Haslam, Lovell and Hunneman, *Ind. Eng. Chem.*, 17, 272 (1925); also M.I. T. Publications, *Serial* 123.

[6] "Experiments on Rate of Heat Transfer from a Hot Gas to a Cooler Metallic Surface," Babcock and Wilcox Co., New York, 1926.

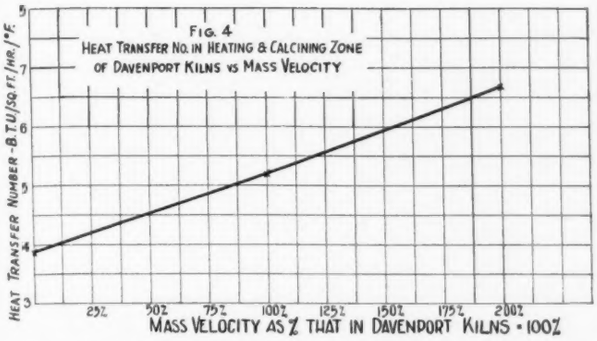


FIG. 4
HEAT TRANSFER NO. IN HEATING & CALCINING ZONE OF DAVENPORT KILNS VS MASS VELOCITY
HEAT TRANSFER NUMBER - B.T.U./SQ.FT./HR./°F.
MASS VELOCITY AS % THAT IN DAVENPORT KILNS • 100%
25% 50% 75% 100% 125% 150% 175% 200%

Fig. 4. Heat transfer number in heating and calcining zone of Davenport kilns vs. mass velocity

radiation. The first part will follow the law of variation with V_m given in Equation 8, while the second is not affected by mass velocity. From these considerations we calculate several points on the curve of Fig. 4 as follows: Assume that the pound mol mass velocity is reduced to one-fourth of 0.0114, the value for the observed kilns, or to 0.0029. The transfer number due to radiation remains equal to 3.22 (assuming the same general temperatures in both cases), but that due to convection is

$$2.0 \times \frac{0.0029^{0.8}}{0.0114^{0.8}} = 0.658$$

The actual transfer number h_e is, therefore, $3.22 + 0.658 = 3.88$. By doubling the mass velocity a similar calculation shows the transfer number to become 6.70.

Heat Transfer in Clinkering Zone

We shall attempt to arrive at a quantitative estimate of the phenomenon of heat transfer in the clinkering zone of the rotary kiln. The analysis will be based almost entirely upon some work by Wohlenberg and Morrow.[7] This seems justified because the phenomenon of oil burning in the kilns observed by the writer is not greatly dissimilar to that of the burning of pulverized coal. The oil, in entering the furnace, is quickly decomposed into gas and finely divided carbon, the latter resembling, in its radiation effect, the fine particles of coal.

In following out this method we are mainly interested in the "furnace absorption efficiency, u_a," which is the fraction of the total energy absorbed in the furnace. Refer to calculation of Case D in paper by Wohlenberg and Morrow. In Case D the furnace is a cubical box with top, bottom and two opposite sides as cold faces, the remaining two sides being refractory faces. The rate of energy liberation is 15,000 B.t.u. per cu. ft. per hr., and the temperature of the cold surfaces is 900 deg. F. abs.

In the observed rotary kiln the rate of energy liberation is about 46,500 B.t.u. per cu. ft. per hr., and the temperature of the cold faces has been taken at 2725 deg. F. abs. Under these conditions the method of calculation shows that 28% of the total energy of the fuel could be absorbed in the clinkering zone, provided processes were carried on in that region which could absorb this heat while maintaining the assumed cold-face temperature. There are liberated in the observed kilns about 33,000,000 B.t.u. per hr. and of this 1,335,000, or about 4%, are actually absorbed in the clinkering zone.

Although these figures cannot lay claim to any high degree of absolute accuracy, they do show an enormous surplus of heat in the clinkering zone, and it may be concluded that, no matter what fuel economies are effected in the rotary kiln, it is unlikely that availability of heat in the clinkering zone will have to be considered as a limiting factor in design.

[7] Wohlenberg and Morrow, *Trans. Am. Soc. Mech. Eng.*, 47, 127 (1925).

Further Studies of Concrete Characteristics

THE STUDIES of Maryland road cores given in recent issues of *Public Roads* were made co-operatively by the University of Maryland, the United States Bureau of Public Roads and the Maryland State Roads Commission. Dean A. N. Johnson of the University's college of engineering has written the most recent report.

This latest published investigation is mainly one of specimens prepared in the laboratory used as a check or in confirmation of the results secured with road cores. The concrete used was a 1:2:3 mix with limestone with a ¾-in. maximum as the aggregate. Tests were made on ages from 7 days to 2 years, but taking the specimens over 30 days old, the average crushing strength was 2618 lb. and the modulus of elasticity was found to be 3,124,000 lb. (In the previous investigation 112 road cores showed an average crushing strength of 3900 lb. and the modulus of elasticity found was 3,562,000 lb.)

Tests on 1:2 mortar specimens more than 30 days old showed an average of 3754 lb. crushing strength and a modulus of elasticity of 3,438,000 lb.

Tests on 1:2 mortar specimens more than 30 days old showed an average of 3754 lb. crushing strength and a modulus of elasticity of 3,438,000 lb.

There was a marked decrease in the modulus of elasticity between the specimens less than 30 days and more than 30 days old, from 3,840,000 lb. to 3,124,000 lb. A trend for the modulus of elasticity to fall off with age was noted, although it was not nearly so marked, with the road cores previously tested. It seems worth noting that the crushing strength of the same specimens increased from 1649 lb. to 2,618 lb. as the modulus of elasticity decreased.

Important tests reported from this investigation were those made on cylinders of wet and dry concrete which had been cured in an identical manner for two years. It was shown that wetting decreased the crushing strength to 73%, from 2360 lb. to 1897 lb. The modulus of elasticity was not affected by wetting, the wet cylinders showing a slightly higher modulus of elasticity than the dry.

The elastic behavior of concrete after heavy loading was a third object of the investigation. Tests for this were made on cylinders of 1:2 mortar, 1:2:3 concrete and neat cement and also on three road cores. The results of these tests, given in some details in the report, show that "in general the effect of overloading concrete temporarily and then having the load released is to reduce somewhat the modulus of elasticity. The specimens suffer a deformation which is not wholly recovered and the apparent elastic limit is raised."

The report ends by saying that no quantative conclusions are warranted from the tests, but they show that concrete behaves in a manner similar to other materials, particularly steel, which exhibit both elastic and plastic properties.

Manufacturers Recommend Research on Wire Rope

A CO-OPERATIVE investigation of the properties and use of wire rope is being urged by representative manufacturers and users of this product to be conducted under the auspices of the American Society of Mechanical Engineers' main research committee. There appear to be no well substantiated facts on which to predict the life of this widely used material or to establish standards for its use. In order that there may be no risk of failure, therefore, thousands of feet of wire rope are discarded each year long before its useful life is completed. Greater knowledge of the material is apparently needed and would, it is felt, bring about increased use for wire rope as well as greater satisfaction to the user.

The New York Building Owners and Managers Association and the Engineering Foundation have already given substantial aid in the development of the project and have promised further support. At a cost of several hundred dollars, the Engineering Foundation has provided a preliminary review of the present state of knowledge of wire rope and its use, for the purpose of revealing lines along which research should be undertaken.

W. H. Fulweiler, member of the A. S. M. E. main research committee, stated that a small commmittee will be appointed to prepare a suggested program of research for wide distribution and comment. Following this a large and more formal conference will be called of all those interested.

Design of Sand and Gravel Washing and Screening Plants

Part I.—Introduction—Caution—Some General Considerations

By Frank M. Welch
Chief Engineer, American Aggregate Corp., Greenville, Ohio

REALIZING that only nine years ago ROCK PRODUCTS published a series of articles which I wrote under the same title as appears above, it is with considerable hesitancy that I again endeavor to go over a territory that has been so recently covered. I have reviewed the old manuscript however, and am quite surprised to find some of the impractical methods that were considered modern nine years ago. On the other hand I am very much gratified at the progress that has been made during that period of time, and am satisfied that our little sand and gravel world is keeping pace with the development in other industries. Having been assured that the reprints of the 1920 series are exhausted, and reminded that new faces and phases appear in the general picture, I shall attempt to bring the old subject up to date.

I realize that gravel as an aggregate has taken such an important position in the world-wide field of construction, that a grave responsibility rests upon the shoulders of those who are preparing it for the commercial market. I further realize that although there are almost endless quantities of our raw material in the world, yet the good deposits, properly located with reference to market and shipping facilities, are beginning to get scarce. And I also realize that in one direction little progress seems to have been made—there are apparently many gravel plants still being built which, on account of one or more of a dozen reasons, should not have been considered, at least until a later date.

Caution Counseled in Gravel-Plant Promotion

The gravel "game" seems to be especially attractive to those inexperienced in its ramifications. It has likewise proven very lucrative to the successful producer, whether his success has resulted from good luck or hard knocks. It may sound inconsistent for one whose livelihood largely depends on his consulting engineering work as a designer and builder of new plants to make such an assertion, but I am nevertheless frank to say that in too many prospective sites for gravel plants, there are more reasons for not proceeding than for going ahead.

The situation is not exactly comparable to that of the oil well business, where one in ten thousand strike it rich and the rest go broke, but the fact still remains that any out-cropping of gravel looks like a gold mine to the uninitiated, and some of the boys apparently require a lot of initiating before it "takes."

Frank M. Welch

Introduction

THE author really needs no introduction to readers of ROCK PRODUCTS. His previous series of articles on the same general subject are now a classic in rock products literature. Frank M. Welch has probably designed more sand and gravel plants than any other man living, including not only those for his own company, but numerous others. The extensive experience of his company in operation under a variety of conditions gives him a unique opportunity to check operating experience and costs with design.—The Editor.

The gravel business is a substantial, lucrative business if the plant is advantageously located, properly designed mechanically, and efficiently managed. In fact, it has become a basic industry. Its mechanical problems have reached a point where there is no further need for guess work. Considering these facts, there are too many plants losing money. There are too many who think they are making money but are not. There are too few really prosperous ones. It is for the purpose of warning the less experienced and helping the present producer, that I am presenting the following observations which have been made from various angles during the past twenty years.

In tracing the preliminary steps, which lead up to the decision to build a gravel plant, I will discuss the various angles in the order of their relative importance as follows:

DEPOSIT
- *Quality*
- *Depth*
- *Overburden*

LOCATION
- *Market*
- *Transportation Facilities*
- *Competition*

FINANCING

The Deposit

A sand and gravel deposit to be of commercial value should be of great enough extent to justify the installation of a modern plant of as large capacity as the market will require. In other words, the deposit should last throughout a sufficient period of years or more to pay off the installation charges at a minimum of 10% per annum, while showing a net profit over and above the depreciation charges and other overhead expenses.

The deposit should also be deep enough to permit economical excavating. The minimum permissible depth or working face depends on the geographical location. For instance, through some of the Southern States, where good gravel is scarce and where, therefore, a higher market price prevails, an operator can afford to excavate a comparatively shallow deposit. However,

Aeroplane view (by Kalec and Forster, Detroit, Mich.) of the Green Oak plant of the American

Mich.) of the Green Oak plant of the American Aggregate Corp., one of the plants serving the Detroit market

frequent moving of the excavating equipment caused by these shallow deposits often makes the cost of excavating prohibitive, with any standard method.

If an apparently lucrative deposit is found close to a railroad leading to and within reach of a good market, an option should be obtained through some real estate agency and a thorough test made for quality and actual depth. Test holes should be sunk first at all remote corners of the property, succeeded by other holes interspersed between, dividing and subdividing the distance between holes, until a sufficient uniformity appears from one hole to the next to insure a complete log of the deposit. At the same time a test of the overburden is obtained. The maximum allowable thickness of overburden also depends on the prevailing market prices for washed gravel and sand and the comparative depth of the gravel deposit.

There is no set rule governing good commercial quality except a comparison with other deposits which are serving the same market. This comparison should not only keep in mind the actual merits of the gravel and sand, but the percentage of foreign matter and the proportions of coarse and fine material.

Location

Regardless of the merits or quality of the deposit, if it is not properly located, it is of little value at present. This has become more true during the past few years when freight rates have been increasing far beyond the pre-war rates. The freight-rate situation has not only tended to decrease the shipping radius in recent years, but the temporary road-side pits have made serious inroads on many legitimate, modern, permanent plants. It goes without saying that the owner of a good gravel deposit within the limits or within trucking distance of a large or even a medium sized city, is very fortunate. Even though he is without reach of a rail connection, he is "sitting pretty," and if he has the additional railroad service, he may have a "gold mine." I know of a few of these, but they are the exceptions.

Unless located as described above, the deposit should be adjacent or within reach of one or more railroads, the more the better. These railroads should lead to gravel markets within a freight rate comparing favorably with those of the outstanding competitors. If the freight comparison is sufficiently favorable, little consideration need be given the competition, but if not so favorable, a survey must be made to see that the local production is not alrady too great for the demand.

The location also has considerable bearing on the design and type of plant most suited to the prevailing conditions. This is a subject that will be covered later under plant design.

The building of gravel plants too far from the markets not only tends toward an unprofitable investment but usually leads to the wasting or ruining of a perfectly good deposit, which in later years might be of great commercial value.

The matter of financing sand and gravel plants is somewhat outside of the engineer's scope. I can say, however, that from observations which have come to me from time to time, little difficulty is found in financing a large modern plant over a good commercial deposit which is properly located.

The National Crushed Stone Association's Tests of Concrete

Supplementary Report of A. T. Goldbeck Reviewed

By Edmund Shaw
Contributing Editor, Rock Products

THE PROPORTIONS of concrete used for highway construction almost universally are stated in terms of loose, volumetric measurement of the several materials, the most widely used proportions being 1:2:3½. It is no secret that when crushed stone is used as the coarse aggregate, the volume of concrete produced generally is less than when gravel is used in concrete of identical proportions. The reason is that gravel being of rounded particles generally has a smaller percentage of voids than crushed stone with angular particles, even when of the same gradation. It follows that a somewhat lesser amount of cement per cubic yard is used in gravel concrete than in stone concrete.

Crushed stone has borne the brunt of the disadvantages resulting from this old fashioned, entirely illogical method of proportioning concrete, and the present series of tests by the National Crushed Stone Association was started to determine if some other method might not be substituted that would be more logical, and which would give more uniform results and make for more equitable competition between the coarse aggregates.

Reasons for Selected Basis of Comparison

Commercial gravel frequently runs finer in size than crushed stone, simply because that is the way it occurs in nature; the coarse particles are not obtainable or the fine particles predominate. In these tests, although consideration was given to screening the aggregates and recombining, it seemed entirely illogical to make a comparison of crushed stone with its neighboring gravel, screened to the same mechanical analysis, when actually they were not being used in that way. Accordingly the tests were run with the aggregates graded just as they were received; that is, the commercial gradings of the materials as they were being supplied to the job. Any set of comparative tests of materials can be subject to the criticism that they are not strictly comparative. But the fact is that the method of mixing concrete in like arbitrary proportions to the same consistency is the method most generally used in practice, and a comparison on that basis seems the best comparison that can be made. The basis of comparison selected is the basis upon which concretes are judged in actual service today.

Samples of stone were requested from a number of quarries situated throughout the United States, not with the idea of obtaining the best stone available, but rather to obtain stone having as wide a range in physical characteristics as possible. Thus it was desired that the stone extend from the softest to the very hardest, as determined by the Deval abrasion test. The stone producer was also requested to obtain as fair a sample as possible of gravel from a state or county accepted stockpile, and there is every reason to believe that a fair sample was shipped in all cases.

Characteristics of Coarse Aggregates

Table I gives the physical characteristics of the coarse aggregates tested. The column, "Per Cent Wear," contains the results of the Deval abrasion tests on stone samples and the gravel abrasion test described in Bulletin 1216, U. S. Department of Agriculture, on gravel samples. The stone extends in percentage of wear from 2.0 to 7.0, and the gravel from 3.5 to 28.1. It is believed that these respective ranges in percentage of wear include most commercial aggregates. There is no question that Nos. 28 and 31 are far softer than the gravel most commonly used, but, none the less, both these materials are used commercially. In all cases the tests were made in accordance with the standard methods of the American Society for Testing Materials, when such standard methods exist. The apparent specific gravity was obtained by the overflow apparatus described in Bulletin 1216 (referred to above).

The gravel samples had the following characteristics (what follows being condensed somewhat from the original):

No. 3, per cent wear, 10.5. Largely smooth, hard chert fragments and a few fragments of sandstone and shale. Sub-angular and weathered.

No.	Materials	% Retained—Square Openings					% Wear	Apparent Sp. Gr.	Wt./cu.ft. (loose)	% Voids (loose)	% Absorption
		2"	1½"	1"	½"	#4					
2	Stone	....	9	58	83	98	3.5	2.69	91.7	45.3	0.3
3	Gravel	....	2	19	78	99	10.5	2.30	87.3	39.0	2.9
5	Stone	....	3	45	91	99	2.9	2.96	92.3	50.0	0.2
6	Gravel	....	13	41	82	98	16.9	2.63	102.7	37.5	0.7
7	Stone	....	10	39	74	97	7.0	2.58	89.5	44.3	1.3
8	Gravel	....	8	35	78	98	10.7	2.69	103.7	38.2	1.1
9	Stone	8	34	61	85	95	6.7	2.67	95.7	42.5	0.3
12	Gravel	....	....	11	74	99	5.0	2.56	94.6	40.8	0.7
13	Stone	....	13	44	85	98	3.5	2.44	86.2	43.3	2.0
17	Gravel	2	13	51	92	100	8.6	2.55	98.9	37.8	0.6
23	Stone	....	6	33	75	94	2.0	2.62	93.6	42.7	0.1
24	Gravel	1	21	58	91	100	3.5	2.72	103.6	38.8	0.8
27	Stone	....	13	39	71	95	2.8	2.77	97.2	43.8	0.2
28	Gravel	....	3	13	51	93	26.2	2.56	104.9	34.3	0.8
29	Gravel	....	3	36	83	99	3.5	2.56	99.3	37.7	1.0
32	Stone	....	7	50	76	95	2.9	2.61	95.0	41.3	0.3
31	Gravel	....	15	40	71	97	28.1	2.61	103.9	36.2	0.7
35-1	Stone	....	28	57	85	100	3.3	2.76	95.7	44.5	0.3
35-2	Stone	....	28	57	85	100	3.3	2.76	95.7	44.5	0.3

Table I—Showing characteristics of coarse aggregate

No	Coarse Aggregate	Water Ratio	Flow	Wt. Unhardened Concrete, Lbs. per Cu. Ft.	Bags Cement per Cu.Yd.	Compressive Strength	Mod. of Rupture
2	Stone	0.81	163	151 4	6 16	3760	703
3	Gravel	0.88	165	142.4	5 86	3630	558
5	Stone	0 83	165	156.6	6 34	3670	674
6	Gravel	0.84	167	150 6	5 77	3450	535
7	Stone	0 88	161	148 4	6 08	4300	720
8	Gravel	0 85	162	151.4	5 78	3960	678
9	Stone	0.86	164	149 8	5 94	3600	640
12	Gravel	0.85	167	147.6	5 89	3500	599
13	Stone	0.88	162	147.0	6 13	3800	666
17	Gravel	0 81	164	148.4	5 82	3360	555
23	Stone	0.85	165	149.2	6 01	3810	717
24	Gravel	0 81	165	153.6	5 89	3960	679
27	Stone	0 84	168	152.0	6 00	3680	686
28	Gravel	0.88	168	147.6	5 59	3440	535
29	Gravel	0 83	171	147.4	5 77	3840	622
32	Stone	0.86	161	147.8	5 88	3370	638
31	Gravel	0 86	164	148.0	5.63	3160	517
35-1	Stone	0 80	169	153.8	6 13	3620	701
35-2	Stone	0 81	170	152.6	6.09	3770	712

Table II—Properties of concrete with different coarse aggregates. 1:2:3½ mix. Dry, loose volume. Cured 28 days in moist room. Slump approximately 1½ in.

No. 6, per cent wear, 16.9. Quartz, gneiss, conglomerate, sandstone and igneous rocks. Surface not particularly smooth, many fragments weathered and weak. Angular and considerable amount of crushed fragments.

No. 8, per cent wear, 10.7. Limestone with small percentage of sandstone and igneous fragments. Rounded and rough. Considerable percentage of crushed and angular fragments.

No. 12, per cent wear, 5.0. Chert with smooth but slightly pitted surfaces. Subangular.

No. 17, per cent wear, 8.6. Practically same as No. 12.

No. 24, per cent wear, 3.5. Limestone or dolomite, sandstone and igneous rocks, small percentage of chert and quartz. Considerable crushed with rough surfaces.

No. 28, per cent wear, 26.2. Badly weathered quartz. Surfaces rough and pitted, weak subangular fragments.

No. 29, per cent wear, 3.5. Sandstone, shale, quartz and metamorphosed igneous rocks. Surfaces smooth to very rough. Shapes, rounded to quite angular.

The fine aggregate in all cases was Potomac river sand, fineness modulus, 2.82; weight per cubic foot, dry and loose, 98.7 lb.

The methods used for proportioning, mixing, molding and curing (described very fully in the original paper) were such that they insured that the grading of all aggregates was the same as that of the original sample and that all the mixtures were treated in an identical manner. The consistency was measured by a flow table. The methods of storage and curing were almost ideal.

Discussion of Tests

The strength results, both in comparison and modulus of rupture, are shown in Table II. It will be noted that with the arbitrary proportions used there results more cement per cubic yard in the gravel concrete, due to the higher percentage of voids in the stone, as shown in Table I.

Fig. 1. Comparison of crushed stone concrete with gravel concrete. Age, 28 days

Fig. 2. Effect of percentage of wear on modulus of rupture. Age, 28 days

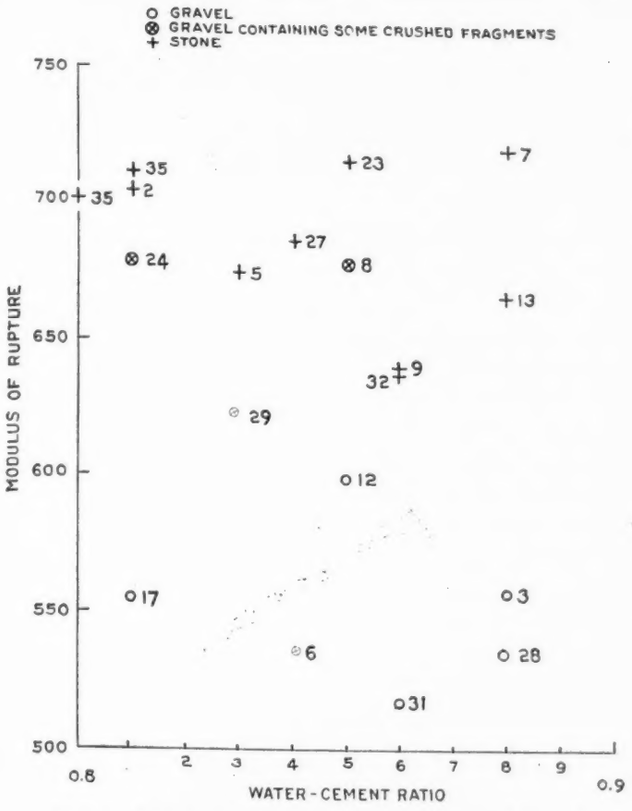


Fig. 3. Effect of water-cement ratio on modulus of rupture. Same mix; age, 28 days

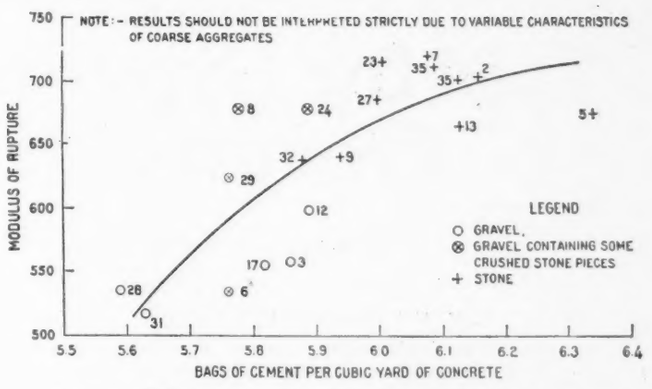

NOTE:- RESULTS SHOULD NOT BE INTERPRETED STRICTLY DUE TO VARIABLE CHARACTERISTICS OF COARSE AGGREGATES
MODULUS OF RUPTURE
BAGS OF CEMENT PER CUBIC YARD OF CONCRETE
LEGEND
GRAVEL.
GRAVEL CONTAINING SOME CRUSHED STONE PIECES
STONE

Fig. 4. Effect of cement content on modulus of rupture. 1:2:3½ mix. Age, 28 days

The only reason for grouping the materials as they are grouped in Table II is that they occur in proximity to one another. The test results may best be seen in Fig. 1.

The discussion of the tests and the summary and conclusion which follow are quoted from the original paper in full: "This figure should not be misunderstood. It may convey the impression that perhaps in all cases stone concrete will necessarily test higher than gravel concrete, but a study of the diagram shows that this is not true. There are some gravel concretes which test higher than some stone concretes, both in compression and modulus of rupture, and perhaps had certain other samples been supplied to us the gravel concrete might have been higher than the stone concrete. It is necessary to emphasize this point, for otherwise the diagram may be misleading.

"Perhaps the results are better shown in Fig. 2. Here it is seen that stones in general have a higher modulus of rupture than gravels, and it seems to be the case that those gravels which have the higher percentages of wear likewise have low resistance to cross bending, as shown by samples Nos. 6, 28 and 31. It is true that they also run low in compression, although not correspondingly low. It also seems to be the case that the limestone gravel which contains some crushed pieces and also sample No. 24, which contains crushed pieces in addition to limestone fragments, give high values of modulus of rupture. It is realized that with the use of arbitrary proportions a low cement content has resulted in some of the gravel concretes, which undoubtedly affects the curve showing the relation of percentage of wear to modulus of rupture. Other tests are needed to eliminate the cement as a variable.

Water Ratio Strength Relation

"In order to see more clearly the effect of the water-cement ratio on the modulus of rupture of the various concretes, the values for modulus of rupture and water-cement ratio have been plotted in Fig. 3. It is seen at a glance that the water-cement ratio seems to have no consistent effect on the modulus of rupture. The range of ratios used for the gravel concretes was practically as large as that used in the stone concretes and where identical water ratios were used the strength of the stone concretes were all higher than those of the gravel concretes.

"To study the effect of cement content per cubic yard on modulus of rupture these values have been plotted in Fig. 4. Here it is seen to be a rather decided trend, for it is noticeable, in a general way, that those concretes having the lowest cement content have the lowest modulus of rupture, and the modulus of rupture tends to increase with increasing cement contents. It is true there are a number of exceptions to this rule and until other tests have been made on the same aggregates, in which the cement content per cubic yard has been made identical, no definite conclusions may be drawn.

"Judging from Fig. 2, a hasty conclusion might lead one to believe that the percentage of wear has a decided influence on the modulus of rupture, but it happens that those aggregates having a low percentage of wear have likewise been graded so that the cement content is also low. Judging from Fig. 4, one might conclude that the cement content has a decided effect on the strength of the concrete, but, on the other hand, those aggregates giving low results not only have a low cement content but also are very weak, as shown by high percentage of wear.

"The general indications from these preliminary tests are:

"1. That there is a wide variation in modulus of rupture, possibly depending on the characteristics of the aggregates, including:

"*a.* Shape and surface characteristics.

"*b.* Percentage of wear.

"*c.* Percentage of voids, which in turn affects the cement content per cubic yard.

"2. There is no relation between water-ratio and modulus of rupture when different aggregates are used.

"3. In general the crushed fragments used in these tests have shown a higher modulus of rupture than the rounded fragments.

"4. That the use of identical arbitrary proportions irrespective of the aggregate characteristics results in concretes which may have a wide variation in modulus of rupture.

"The tests just described are preliminary and will be followed by other tests to throw light on some of the points still open to question. Apparently either the lower cement content of the gravel concrete or the characteristics of the gravel, or both, have resulted in a lower modulus of rupture than is obtained with the stone concrete. Accordingly the next step in the test procedure will be to determine the relations of strength when the cement contents are identical.

Conclusion

"The tests so far made surely indicate the necessity of specifying different proportions for concretes composed of unlike materials if like values for modulus of rupture are to be obtained. Perhaps in some cases this may require more cement in the stone concrete than in the gravel concrete, while in other cases the reverse may be true. The fact remains, however, that the use of identical proportions results in widely varying values for modulus of rupture and this causes lack of economy, considerable variation in the service value of road slabs and inequitable competition between aggregates."

Tags for Gypsum and Other Rock Products Shipped in Bags

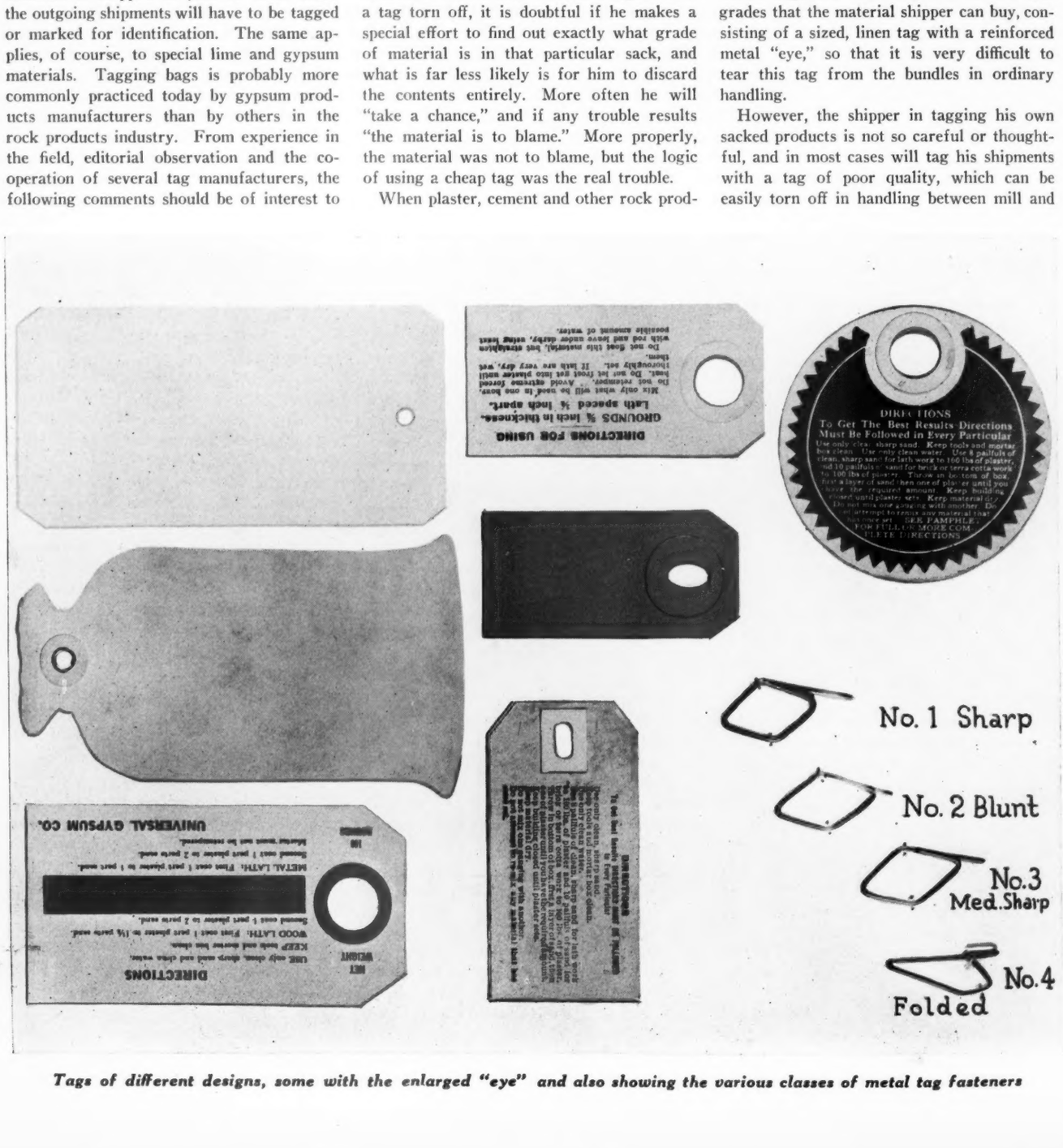
A Description of Some of the Later Types of Tags and Fasteners

WITH THE ADVENT of the new high early strength portland cements that are, in several instances, manufactured by the cement companies along with the ordinary portland cement, it is obvious that when the material is shipped in jute or cloth sacks the outgoing shipments will have to be tagged or marked for identification. The same applies, of course, to special lime and gypsum materials. Tagging bags is probably more commonly practiced today by gypsum products manufacturers than by others in the rock products industry. From experience in the field, editorial observation and the cooperation of several tag manufacturers, the following comments should be of interest to all plant executives and sales managers.

The purpose of a tag is to identify the contents of the sack. If the tag is not there, for any reason, it is difficult for anyone to identify the sack's contents. In case a warehouseman finds a sack without a tag or with a tag torn off, it is doubtful if he makes a special effort to find out exactly what grade of material is in that particular sack, and what is far less likely is for him to discard the contents entirely. More often he will "take a chance," and if any trouble results "the material is to blame." More properly, the material was not to blame, but the logic of using a cheap tag was the real trouble.

When plaster, cement and other rock products material are shipped in returnable sacks, the shipper usually supplies the dealer or buyer with a certain number of tags, suitably printed, the tags being intended for use in returning the empty sacks to their source. These bags are invariably one of the best grades that the material shipper can buy, consisting of a sized, linen tag with a reinforced metal "eye," so that it is very difficult to tear this tag from the bundles in ordinary handling.

However, the shipper in tagging his own sacked products is not so careful or thoughtful, and in most cases will tag his shipments with a tag of poor quality, which can be easily torn off in handling between mill and



Tags of different designs, some with the enlarged "eye" and also showing the various classes of metal tag fasteners

place of use. The loss of this tag is sometimes followed by serious construction or application difficulties, especially where the plaster or special cements are involved.

As one dealer put it, "Why is it that on shipments I make to you, you supply me with a linen tag of the best grade available, and on shipments you make to me, any old tag will do? I am just as anxious to have my stuff come properly tagged as you are."

To assist rock products manufacturers in finding a really suitable tag for their products. ROCK PRODUCTS asked tag manufacturers to submit samples of tags now commonly used in the industry. From the hundred or so samples received, the poor quality of some of the tags in use was apparent, but what was more pronounced was the wide variety of colors of tags used by different manufacturers to tag material of the same identical composition. There were blue, red, white and miscellaneously colored tags, all intended to be used on the same kind of material. Why would it not be more practical and to the point to have all tags for a certain product to always be the same color? For example, the gypsum products manufacturers, through their association, could adopt a blue tag for fibered hardwall, to be used by all the members; then, in the event this type of tag were torn off or partly destroyed, there would be left, 99 times out of 100, that part of the tag which reinforces the "eye," and the piece would be of sufficient size to at least show the color of the original tag, and the warehouseman could identify the *kind* of material by this color. He might not be able to identify its source except from the printing on the sack itself, which is not always reliable and in this case of minor importance.

Likewise, the cement manufacturers could establish now a tag of standard color for high early strength cements, and probably save money that might otherwise go to settle adjustments due to loss or lack of a proper tag.

The size of the tag or its printing does not call for standardization, and in fact several of the tags received were very unique and novel as to shape and printing, both points no doubt being of advertising value.

Tag Fasteners

Wire ties ordinarily used for tying sacks were originally supplied with the looped ends, and as the eye of the tag was much smaller than the wire loop, some means were necessary to fasten the tag to the sack. This led to the use of wire fasteners which could be fastened to the sack itself by forcing the end of the clip or fastener into the fabric of the cloth or by passing the clip through the eye of the tag and then passing the loop wire tie through this fastener.

From the cement manufacturers' standpoint this method is far superior to forcing the fastener into the cloth fiber, as otherwise the tag is not always removed at the place of use, and if it is removed it usually is jerked out, leaving a small hole in the sack at that place. On large return shipments the labor involved in removing several thousand tags and fasteners from sacks, where very often the tag will be partially hidden from view, making necessary turning the sack over, is no small item of expense.

Development of Various Types of Wire Fasteners

Originally fasteners were designed merely to make quick and secure tag fastening possible. Roughly cut with burred edges, these first fasteners caused much distress (Fig. 1) not only to freight and warehouse handlers, but to handlers at the mill of the empty sacks. These sharp fasteners would catch unwary or fast-moving hands and scratch and tear the unprotected flesh, so that in time necessity dictated the appearance of a blunt-end fastener similar to those in Fig. 2. These overcame the cuts and tears received by handlers, but were not as convenient to use on a job, tedious at best. Hence the fastener with a sharp point reappeared, but in a form similar to those in Fig. 3. A smooth point with burrs and rough edges missing, this proved to be not only convenient in assembling shipments, but a fastener without a terrible menace. The sharp point, however, still caused occasional trouble, and it was not until types of fasteners similar to those in Fig. 4 appeared that the hazard of injury from metal fasteners was entirely removed. Lending themselves to quickly and easily preparing shipments, they are safe in the hands of anyone who may handle the shipment from its inception to its final disposal.

The next logical development was the introduction of a tag with an exceptionally large "eye" so that wire ties, either loop or upset ends, could be readily passed through the "eye" of the tag, doing away with the use of tag fasteners for this particular work. No samples were received having the large "eye" reinforced with metal, although this type probably could be secured at a small additional cost. Some of the large-eyed tags, as can be seen in the cut, are provided with a slotted "eye," and for quick tying the circular-holed tag is preferable, as its use speeds up the tying operation, and where thousands of tagged sacks are tied daily the increased cost of this type of tag can be saved many times over.

The cost of tying tagged sacks using the small-eyed tag will cost 75% more where plain untagged sacks are tied, and with the large circular-eyed tag will only be roughly 30% more. In comparatively small operations the cost of tying untagged sacks will be approximately $1 per thousand, while with the the old style tag the tagged sacks will cost $1.75 per thousand. The large-eyed tag will make it possible to cut tagging and tying cost to $1.25 or $1.30 per thousand.

With the more recent automatic tying machine, jute sacks can of course be tied cheaper than these figures indicate, but the machines do not lend themselves for application on tagged sacks.

Program of Simplification for Shipping Tags Planned

MANUFACTURERS, distributors and users of shipping tags were invited by the Department of Commerce to attend a general conference for a proposed simplification program for shipping tags held in New York City on April 26. The department announced the purpose April 10 in a statement which follows in full:

"This conference is being conducted at the request of the industry, according to George Schuster of the Division of Simplified Practice, who has been representing the Bureau of Standards in the development of the proposed simplification. The simplified practice committee of the shipping tag manufacturers submitted a proposal to the division with the request that the division organize the general conference of all interested elements to consider it. The proposal has the unanimous approval of manufacturers who contributed to its development."

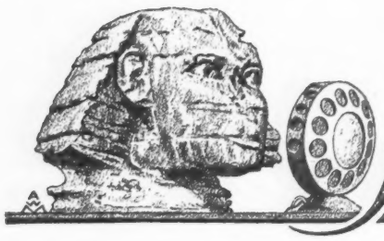
In announcing the date for the general conference, Mr. Schuster pointed out that comparison of the simplified schedule proposed by the industry, with the existing variety of tags, discloses the fact that the proposed simplification would reduce the sizes of tags from 16 to 8, grades of stock from 21 to 9, thickness of stock from 7 to 5 and colors from 32 to 15.

Buffalo Man Plans Alabama Lime Development

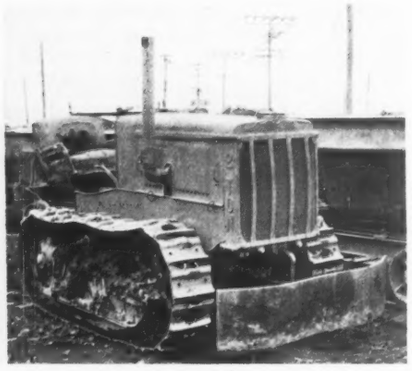
FRANCIS L. HOFF, president of the National Lime, Cement and Byproducts Corporation, with extensive lime rock deposits in the Muscle Shoals section on the Tennessee River, where the corporation is building a plant for the manufacture of one thousand barrels of hydrate lime per day, as well as other byproducts, has lived in Buffalo, N. Y., 43 years.

Mr. Hoff's early training was as a clerk in a country store, and later was in the editorial department of the Lawyer's Co-operative Publishing Co. He was also connected with the Wayne County Canning Association in Newark, N. J.

Mr. Hoff has two sons, both of whom were in France during the World War. Schuyler L. Hoff, lieutenant in the aviation service, and Nelson Pruyn Hoff, in the motor dispatch rider service. Nelson is editor of the Blue Book of Alabama and will, when the Blue Book is completed, be the vice-president and sales manager of the National Lime, Cement and Byproducts Corp. Nelson is a graduate of Nichols Preparatory School of Buffalo. Schuyler L. Hoff, now secretary and assistant treasurer of the National Lime, Cement and Byproducts Corp., is also a graduate of Nichols Preparatory School and an alumnus of Yale University. —*Buffalo* (N. Y.) *Times.*



Hints and Helps for Superintendents



Tractor equipped with a bumper used particularly for spotting cars

Tractor Used as Car Shifter and Puller

AT the shale pits which supply the new Velo plant of the Missouri Portland Cement Co., Prospect Hill, Mo., near St. Louis, the 1¼-yd. Koppel cars, of which the company has between 100 and 125, are loaded in a slight depression at the quarry face. The cars after loading are pulled out of this depression by a Caterpillar tractor in trains of 2 to 16 cars at each trip, the number of cars that can be pulled depending entirely upon weather conditions, rains causing slippery ground and hence less traction.

Ordinarily the cars are pulled up with a short length of cable, but occasionally, especially for switching purposes, the cars are pushed by means of a bumper on the tractor. This bumper was made by riveting to two channels fastened to the tractor chassis.

As the pit is only a few hundred yards from the shale crushing plant, the number of cars in active service is only a small percentage of the total owned, but any extra cars are kept filled with shale and are protected from rain by individual canvas covers, so they are always ready for use.

Chart of Indicators Useful for pH Measurements

By CLARKE E. DAVIS and HENRY M. SALISBURY

(Reprinted from *Industrial and Engineering Chemistry*)

THE accompanying chart of the indicators has been found to be very useful in quickly judging the pH of solutions and of spot tests on dry materials. It was compiled by noting the color produced when 4 drops of each indicator were added to 10 c.c. sets of the buffer solutions recommended by Clark and Lubs.[1]

Indicator	Concn. of Soln. Per cent	Solvent	pH Range
Methyl violet	0.10	1% alcohol	1.0 to 3.2
Thymol blue (acid range)	0.04	Water	1.4 to 2.8
Bromophenol blue	0.04	Water	3.0 to 4.6
Methyl orange	0.02	Water	3.0 to 4.8
Bromocresol green	0.02	Water	3.2 to 5.8
Methyl red	0.02	60% alcohol	4.4 to 6.0
Propyl red	0.02	60% alcohol	4.8 to 6.4
Bromocresol purple	0.04	Water	5.2 to 6.8
Bromothymol blue	0.04	Water	6.0 to 7.6
Phenol red	0.02	Water	6.8 to 8.4
Cresol red	0.02	Water	7.2 to 8.8
Phenolphthalein	1.00	95% alcohol	7.8 to 8.5
Thymol blue (alkaline range)	0.04	Water	8.0 to 9.6
Cresolphthalein	0.02	95% alcohol	8.4 to 10.0
Thymolphthalein	0.20	95% alcohol	9.4 to 10.0

Most of the indicators are of the Clark and Lubs[2] series with the addition of a few others in common use. The one called Combination A is a 50-50 mixture of methyl red and bromothymol blue that has been found very useful because of its wide range in color changes from pink at pH 4.8 through orange, yellow, green and finally blue at pH 7.4. Bromocresol green as suggested by Cohen[3] has been found to be very useful over its range.

The parabolas and ellipses are used in this chart to show, by their overlapping, the blending of one color with another. Diminution or increase in color strength is shown by a decrease or increase of the vertical width of the parabola or ellipse.

The indicators were made up as shown in the table.

In using this chart to test solutions, 4 drops of the indicator are added to 10 c.c. of the solution and the color is then compared with the colors noted on the chart. When used for a spot test on dry material only a very small amount of the indicator is applied directly to the material under examination and reference made to the chart after a moment or so.

Where possible, the use of several indicators is advised in order to give a more accurate judgment of the pH. In some parts of the pH range the pH can be judged with an

[1] Clark and Lubs, *J. Biol. Chem.*, **25**, 479 (1916).
[2] Clark and Lubs, *J. Bact.*, **2**, 1, 109, 191 (1917).
[3] Cohen, U. S. Pub. Health Service, *Pub. Health Repts.*, **38**, 199 (1923); **41**, 3051 (1926).

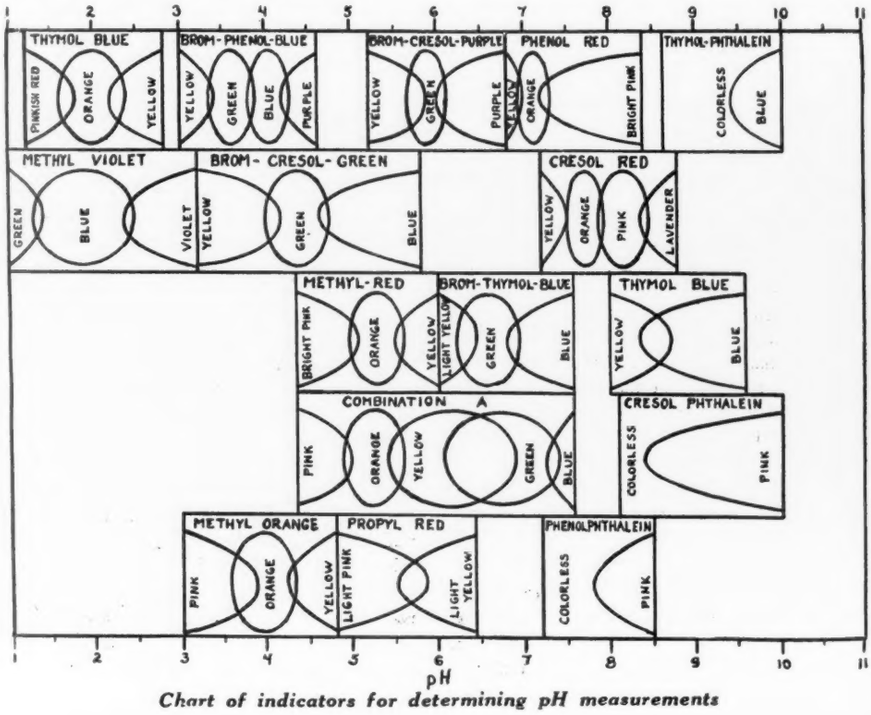


Chart of indicators for determining pH measurements

accuracy of ±0.2. The operator's accuracy can also be increased by the use of buffer solutions for comparison.

Electrical measurements on unknowns followed by the use of indicators will also help the operator to judge the finer shades of color.

Calculating Tonnage Carried by Belt Conveyors

VERY often it is convenient to know the within-reasonable-limits tonnage that a belt conveyor is delivering, or, where there are several sizes of crushed stone flowing from different bins to the same belt for making a mixed aggregate, to know the percentages of each of these different size products in the mixture. At some plants where these percentages are desired, various unwieldy screening devices are used, but the crushed stone producer can well consider the method used for getting this information in the phosphate fields of Florida.

At these operations belt conveyors run in tunnels under the various storage silos, the different silos containing phosphatic material of different sizes and grades. The problem is to draw phosphate pebble from a high-grade storage pile and mix with it, as much as technical practice will permit, some of the lower grade phosphate ores.

At the plant of the Phosphate Mining Co., Nichols, Fla., light, shallow, rectangular, metal pans, 2 ft. long, are provided. These are of the same width as the belt conveyor. One of these pans is placed empty on the moving belt and allowed to pass under the loading spout, after which it is immediately removed and the contents weighed. As the rate of travel per minute of the belt, and consequently that of the pan, is known or can be easily ascertained, and as the weight of the pan contents has been secured, then the tons per hour can easily be computed. If two spouts are being used for loading two different sizes or grades, then by using two pans in the above manner the percentages of each can be found in a shorter time than it takes to tell it.

The process or method in essence then consists of removing a section of the carried material 2 ft. long at frequent intervals, and from this with the ft.-per-min. speed of the belt conveyor and the total time the belt operates, the tons delivered can be arrived at readily.

Chain Grizzlies

IN the north central section of the United States, notably in the iron producing sections of Minnesota, grizzlies of the chain type are finding increasing favor, and there is no question but what all crushed stone producers would do well to familiarize themselves with this type of equipment.

At the plant of the Quinn Stone and Ore Co., Fort William, Ontario, where the picture was taken, a chain grizzly has been found adaptable for solving a rather knotty problem. This whole operation was described in detail in the March 30, 1929, issue of ROCK PRODUCTS, but suffice it here to say that increased tonnage, better grading and more economical operations were a direct result of this expedient.

A particular feature of this chain grizzly is its device for cleaning. The cut shows two short pieces of 20 lb. rails fastened together by short chains, to form a drag, and the whole riding the return chain of the grizzly. This acts to scape off any slabby chunks of stone that might otherwise endanger the sprockets of the drive mechanism.

Elevator Belt Protection

ROCK falling from an open bucket elevator between the belt and the tail pulley is responsible for most of the wear and damage of a bucket elevator belt and many are the devices which have been tried to overcome this trouble.

At the plant of the Carolina Road Granite Co., Elm City, N. C., a wedge shaped rider has been devised and installed, as shown in the accompanying cut, in such a manner as to divert to either side any falling stone. In operation the wedge lies against the belt lightly, being prevented from wearing too heavily by rope and counterweight arrangement.

At the time the accompanying picture was taken the elevator was not in operation and shows the rider thrown away from the belt due to the riveted lap, otherwise the protector lays lightly against the bucket elevator belt.

The under side of a chain grizzly showing the plates in position to scrape pieces of stone off and thus protect the driving mechanism

A wedge-shaped rider over the return side of a bucket elevator serves to throw falling stone away from the belt

President Asks for Limited Tariff Revision

RECOMMENDING LEGISLATION for farm relief, limited tariff revision, the decennial census, reapportionment of Congressional representation, and suspension of the national origins clause of the immigration act of 1924, the message of President Hoover, consisting of only about 2000 words, read to the special session of seventy-first Congress recently, followed the general tenor that had been expected.

Reiterating the view expressed in his inaugural address, the President asked for only limited changes in the tariff. "We find," said he, "that there have been economic shifts necessitating a readjustment of some of the tariff schedules."

"Seven years of experience under the tariff bill enacted in 1922 have demonstrated the wisdom of Congress in the enactment of that measure," the President continued. "On the whole it has worked well. In the main our wages have been maintained at high levels; our exports and imports have steadily increased; with some exceptions our manufacturing industries have been prosperous. Nevertheless, economic changes have taken place during that time, which have placed certain domestic products at a disadvantage and new industries have come into being, all of which creates the necessity for some limited changes in the schedules and in the administrative clauses of the laws as written in 1922."

Basis Suggested for Tariff Changes

Fixing a basis upon which changes should be made, the President said:

"It would seem to me that the test of necessity for revision is in the main whether there has been a substantial slackening of activity in an industry during the past few years, and a consequent decrease of employment due to insurmountable competition in the products of that industry. It is not as if we were setting up a new basis of protective duties. We did that seven years ago. What we need to remedy now is whatever substantial loss of employment may have resulted from shifts since that time.

"No discrimination against any foreign industry is involved in equalizing the difference in costs of production at home and abroad and thus taking from foreign producers the advantages they derive from paying lower wages to labor. Indeed, such equalization is not only a measure of social justice at home, but by the lift it gives to our standards of living we increase the demand for those goods from abroad that we do not ourselves produce. In a large sense we have learned that the cheapening of the toiler decreases rather than promotes permanent prosperity because it reduces the consuming power of the people.

"In determining changes in our tariff we must not fail to take into account the broad interests of the country as a whole, and such interests include our trade relations with other countries. It is obviously unwise protection which sacrifices a greater amount of employment in exports to gain a less amount of employment from imports."

Recommends More Power for Tariff Commission

Turning to the need of important revision in some of the administrative phases of the tariff, the President recommended that the Tariff Commission should be reorganized and placed upon a basis of higher salaries "in order that we may at all times command men of the broadest attainments."

Frank H. Smith Answers Opponents of Cement Tariff

A STUDY of the American cement industry just completed by the United States Tariff Commission definitely refutes the assertion that a duty on cement will raise American cement prices throughout the country, according to Frank H. Smith, president of the Portland Cement Association.

"The finding of the Tariff Commission in its summaries of tariff information just issued for use of the Committee on Ways and Means," said Mr. Smith, "definitely confirms the statement American cement manufacturers made to the Ways and Means Committee that the duty asked on cement could not be reflected in an increase in price to the consumer except to permit the American manufacturer to sell his cement at a reasonable price in markets where he is now forced to sell below his cost of production in an attempt to meet foreign competition.

"On page 2264 of the printed summary of tariff information, the Commission says:

"Portland cement is sold in keen competition between domestic producers in most localities. The mills in various sections which ordinarily supply the large markets at seaboard points also compete at such points with foreign cement imported largely from Belgium.

"The economic position of the industry absolutely precludes any general increase in the mill price of cement. In 1928 the American cement industry was built to an annual capacity of 227,080,000 bbl. The production on the other hand was only 173,206,513 bbl. which in turn was more than 1,000,000 bbl. in excess of its shipments to home markets. As these cement plants are operated by 94 different companies, the largest of which produces approximately 10% of the total output of the industry, and as the industry in recent years has always had a capacity far in excess of its home market, the finding of the Tariff Commission that cement is sold in keen competition is obviously sound and the suggestion that a tariff duty would limit such competition is clearly unjustified. This position is further exploded by the price history of the industry itself. From 1890 to 1913, during which time cement was protected under successive tariff acts, the annual average mill price for cement, as shown by statistics published by the United States Bureau of Mines, dropped steadily from $1.67 a barrel in 1896 to $1.01 in 1913. In the subsequent periods of underprotection and after the price readjustments following war inflation, the mill price of cement dropped from $2.02 a barrel in 1920 to $1.60 a barrel in 1928.

"The Tariff Commission further proves the contention of the American manufacturers that regardless of volume of imports as compared with domestic production, such imports have definitely injured the American industry. The Commission says (page 2264):

"The prices of domestic cement at Boston, Mass., Charleston, S. C., and other seaboard points where considerable quantities of foreign cement have been imported, are on the whole lower than the prices at inland marketing points in the areas adjacent to such markets.

"The dollars and cents proof of this statement is contained in the supplemental brief filed by the American manufacturers and printed in the hearings of the Ways and Means Committee—namely, that of the 18,500,000 bbl. of American cement sold in 1928, at an American seaport, in direct competition with foreign cements, more than 14,000,000 bbl. or 8% of total American production sold below the delivered cost of such cement in such markets, and that 48% of the American mills shipping to seaport markets in 1928 shipped at a loss because of competition with each other in an effort to protect their markets from going entirely to foreign cement."

Pennsylvania-Dixie Incorporates Pyramid Portland in Its Organization

THE Pennsylvania Dixie Cement Corp. of New York City, has acquired the business and property formerly owned or operated by the Pyramid Portland Cement Co. of Delaware. After April 10th, the business will be conducted by the Pennsylvania Dixie corporation, and the product will be marketed under the brand name of "Penn-Dixie." The former plant of the Pyramid company is at Valley Junction, Iowa.

The existing contracts of the Pyramid company will be taken over by the purchaser and carried out by it. The organization for the Valley Junction plant will include Conrad C. Miller, manager, Hardy Magrath, sales manager, R. J. Hild, assistant sales manager, R. A. Bechtold, superintendent, and Guy D. Pitts, assistant treasurer. The local offices will be in the Insurance Exchange Bldg., Des Moines, Iowa.

The incorporation of this unit raises the total number of Penn-Dixie plants to eight, with a total capacity of 12,200,000 bbl. per year.

Editorial Comment

Applied Eugenics

Those who have followed the trend of discussion at the sectional safety meetings, this year, held under the auspices of the Portland Cement Association, must have noted the growing interest in industrial hygiene. More and more accidents (and accident hazards) are being linked with the diseased, unhealthy, physically and mentally unfit worker. A plant physician retained to make regular medical examinations of employes and prospective employes is now a common practice. Thus will economic pressure eventually bring about what idealists, futurists and cranks have sought to accomplish—the adoption of the practice of eugenics—the elimination of the unfit, since they will have no place in our future industries.

Stone and Gravel Tests

A. T. Goldbeck's paper, giving the results of tests on stone and gravel concrete, which has created such a stir since it was read in the National Crushed Stone Association convention and published in ROCK PRODUCTS, February 2, is now supplemented in an amplified and extended form in the *Crushed Stone Journal* for March, 1929. The impression this leaves is altogether different from that gained by reading the previously published partial report of the tests. The conclusions drawn in the present paper are that arbitrary proportioning is quite out of date and that it will be necessary to design concrete mixes according to the materials used, if like values of the modulus of rupture are to be obtained. It is hard to see how anyone, producer or engineer, can find fault with that. Engineers everywhere are recognizing that the characteristics of the aggregates used should be taken more into account, and the trend of the Bureau of Public Roads publications is in that direction. It is for lack of such information as that developed by this series of tests that engineers have gone on designing concrete by the water-cement ratio, which controls the compressive strength, and then using the concrete for purposes where transverse strength is most important. As the paper discussed shows, there is no consistent relationship between water-cement ratio and transverse strength where different aggregates are used.

If one forgets *gravel vs. stone* and considers the materials tested simply as aggregates, the noteworthy portions of the paper are the tables and diagrams which show that the higher moduli of rupture (which measure the transverse strength) were obtained by (1) concrete from aggregates which showed the lower percentages of wear, and (2) concretes which contained the higher percentages of cement. The paper says it is probable that both percentage of wear and percentage of cement affect the transverse strength, but it is difficult to say so definitely because some of the samples which showed a high percentage of wear yielded concrete with a low cement content. But the trend of the curves is so much that way that such a conclusion seems not only fair and reasonable but highly important. There have been other tests showing that the transverse strength of concrete was affected by the characteristics of the aggregate, but these are the first noted in which an attempt has been made to determine what these characteristics are and how much each affects transverse strength.

But the method chosen for grouping the tests, pairing stone and gravel from the same locality, does not seem entirely scientific or even reasonable for the purpose in mind. There are eight of such groupings, eight out of all the innumerable possible groupings, so the comparison proves no more than that there are eight places in the United States where concretes made from certain local crushed stones have higher moduli of rupture than concretes made from certain local gravels. Mr. Goldbeck is too much of an engineer and too fair-minded a man to conclude from this that stone concretes everywhere and always have a greater transverse strength than gravel concretes. He specifically denies this in the paper and says in its conclusion that it is possible that in other localities stone may need more cement than gravel to make concrete of the same modulus of rupture.

Such a comparison was unfortunate, for it may be taken as a challenge. Unquestionably eight other localities in the United States could be found from which to obtain similar test data to use against crushed stone. Then a foolish war of words and tests might follow, a war based on unjustified assumptions which could not lead to a decision because no decision is possible. In the last analysis it is the characteristics of the *individual aggregate,* whether stone, gravel or slag, that governs the value of its use in concrete, and not the characteristics of the class to which it belongs. Even in this report's group of eight, there are two gravels (Nos. 8 and 24) which show a higher modulus of rupture than three stones (Nos. 9, 13 and 32) and equal one (No. 5).

However, this grouping of tests does not detract from the real value of Mr. Goldbeck's paper—*the pointing out of the absurdity of specifying concrete,* in which all kinds of aggregate are to be used, to be made *by arbitrary proportions* and also in showing what characteristics of aggregates probably most affect the transverse strength of concrete. It has added something to our knowledge of aggregates; and when he reports on the further tests as promised, in which variables are to be eliminated by using a uniform cement content, and perhaps by designing special mixes for each aggregate, still more will be added to our knowledge of aggregates.

Financial News and Comment

RECENT QUOTATIONS ON SECURITIES IN ROCK PRODUCTS CORPORATIONS

Stock	Date	Bid	Asked	Dividend
Allentown P. C. 1st 6's[29]	4-24-29	90	.....	
Alpha P. C. new com.	4-22-29	50	53	75c qu. Apr. 15
Alpha P. C. pfd.[2]	4-22-29	116	.....	1.75 Mar. 15
American Aggregates com.	4-24-29	40	45	75c qu. Mar. 1
Amer. Aggregate 6's, bonds	4-24-29	107	109	
American Brick Co.	4-22-29	16	17	25c qu. Feb. 1
American Brick Co. pfd.	4-22-29	86½	87	50c qu. Feb. 1
Am. L. & S. 1st 7's[29]	4-24-29	100	102	
American Silica Corp. 6½'s	4-24-29	96	100	
Arundel Corp. new com.	4-23-29	39	40	50c qu. Apr. 1
Atlantic Gyp. Prod. (1st 6's & 10 sh. com.)[10]	4-24-29	no market		
Atlas P. C. com.	4-22-29	47	50	
Atlas P. C. pfd.	4- 8-29	50	.....	66⅔c qu. Apr. 1
Beaver P. C. 1st 7's[20]	4-18-29	98	100	
Bessemer L. & C. Class A[4]	4-19-29	35½	36	75c qu. May 1
Bessemer L. & C. 1st 6½'s[4]	4-19-29	98	98½	
Bloomington Limestone 6's[20]	4-24-29	92	94	
Boston S. & G. new com.[18]	4-22-29	20	23	
Boston S. & G. new 7% pfd.[18]	4-22-29	50	52	
Canada Cem. com.[43]	4-22-29	29½	31	
Canada Cem. pfd.[43]	4-22-29	96	97¼	1.62½ qu. Mar. 30
Canada Cement 5½'s	4-19-29	98¾	99	
Canada Cr. St. Corp. 1st 6½'s	4-19-29	98	100	
Canada Gyp. & Alabastine	4-22-29	112½	113	75c Jan. 2
Certainteed Prod. com.	4-23-29	22½	23	
Certainteed Prod. pfd.	4-23-29	57½	66	1.75 qu. Jan. 1
Cleveland Stone new st'k	4-23-29	71	75	$10 ex. Apr. 15 50c June 1
Columbia S. & G. pfd.	4-22-29	90¼	92¼	
Consol. Cement 1st 6½'s, A[42]	4-24-29	92	96	
Consol. Cement 6½% notes	4-24-29	78	82	
Consol. Cement pfd.[29]	4-24-29	50	60	
Consol. Oka S.& G. 6's (Canada)	4-19-29	101	103	
Consol. S. & G. com. (Canada)	4-22-29	.....	17	
Consol. S. & G. pfd. (Canada)	4-22-29	80	89	
Construction Mat. com.	4-23-29	32	32⅞	
Construction Mat. pfd.	4-23-29	45½	46½	87½c qu. May 1
Consumers Rock & Gravel, 1st Mtg. 6's, 1948[18]	4-19-29	97	99	
Coosa P. C. 1st 6's[29]	4-24-29	50	55	
Coplay Cem. Mfg. 1st 6's[40]	4-24-29	90	.....	
Coplay Cem. Mfg. com.[40]	4-24-29	15	.....	
Coplay Cem. Mfg. pfd.[40]	4-24-29	75	.....	
Dewey P. C. 6's[30] (1930-41)	4-24-29	98½	101	
Dewey P. C. 6's (1942)	4-24-29	101½	.....	
Dolese & Shepard[7]	4-23-29	115	120	$2 qu. Apr. 1
Edison P. C. com.[19]	4-22-29	50c	.....	
Edison P. C. pfd.[19]	4-22-29	1	.....	
Edison P. C. bonds	4-22-29	75	.....	
Giant P. C. com.	4-12-29	36½	.....	
Giant P. C. pfd.	4-22-29	35	40	
Ideal Cement, new com.	4-23-29	75	78	75c qu. Apr. 1
Ideal Cement 5's, 1943	4-24-29	106	109	
Indiana Limestone units (5 shs. com. & 1 sh pfd.)	4-24-29	100	.....	
Indiana Limestone 6's	4-18-29	91	.....	
International Cem. com.	4-23-29	92¾	93½	$1 qu. Mar. 28
International Cem. bonds 5's	4-23-29	106½	110	Semi-ann. int.
Iron City S. & G. bonds 6's[60]	4-19-29	93	97	
Kelley Is. L. & T. new st'k	4-23-29	56	60	62½c qu. Apr. 1
Ky. Cons. Stone Co. com.[48]	4-18-29	14	15	
Ky. Cons. St. com. Voting Trust Certif.[48]	4-18-29	14	15	
Ky. Cons. Stone 6½'s*[48]	4-18-29	96	100	
Ky. Cons. St. Trustee Certif.[48] (1 Sh. 7% cum. pfd. & 1 sh. com. stock)	4-18-29	99	102	
Keystone Sand & Sup. 6's[47]	8-22-28	99	100	
Lawrence P. C.[2]	4-19-29	93	98	
Lawrence P. C. 5½'s, 1942	4- 3-29	93½	95	
Lehigh P. C.[3]	4-23-29	57	58	62½c qu. May 1
Lehigh P. C. pfd.[2]	4-23-29	110	110¾	1¾% qu. Apr. 1
Lyman-Richey 1st 6's, 1932[13]	4-22-29	98	100	
Lyman-Richey 1st 6's, 1935[13]	4-22-29	97½	99	
Marblehead Lime 6's[14]	4-23-29	98	100	
Material Service Corp.	4-23-29	35	.....	50c qu. Mar. 1
Mich. L. & C. com.[6]	4-22-29	35	.....	
Missouri P. C.	4-23-29	44¼	45	50c qu. Feb. 1
Monolith Midwest[9]	4-18-29	8½	10	
Monolith bonds, 6's	4-18-29	97	98	
Monolith P. C. com.[9]	4-18-29	14	14½	8% ann. Jan. 2
Monolith P. C. pfd.[9]	4-18-29	9	9½	
Monolith P. C. units[9]	4-18-29	32	33½	
National Cem. (Can.) 1st 7's[38]	4-22-29	98	.....	
National Gypsum A com.	4-23-29	15	16½	
National Gypsum pfd.[35]	4-23-29	47	51	
Nazareth Cem. com.	4-19-29	27	30	
Nazareth Cem. pfd.	4-19-29	100	105	
Newaygo P. C. 1st 6½'s[29]	4-24-29	102	103	
New Eng. Lime 1st 6's[14]	4-19-29	97	100	
N. Y. Trap Rock 1st 6's	4-23-29	99	.....	
North Amer. Cem. 1st 6½'s	4-19-29	69½	70½	
North Amer. Cem. com.	4-19-29	8½	10	
North Amer. Cem. 7% pfd.	4-19-29	31	37	
North Amer. Cem. units	4-24-29	32	39	
North Shore Mat. 1st 5's[15]	4-24-29	97	.....	
Northwestern States P. C.[37]	4- 5-29	150	160	
Ohio River S. & G. 6's	4-22-29	94	97	
Pac. Coast Cem. 6's, A	4-18-29	92	96	
Pacific P. C. com.	4-18-29	26	27	
Pacific . P. C. pfd.	4-18-29	78	82	1.62½ qu. Jan. 5
Pacific P. C. 6's	4-18-29	97¾	.....	
Peerless Egyp'n P. C. com.[21]	4-19-29	2⅛	2½	
Peerless Egyp'n P. C. pfd.[21]	4-19-29	70	78	
Penn-Dixie Cem. 1st 6's[29]	4-23-29	92¾	93	
Penn-Dixie Cem. pfd.[28]	4-23-29	82	83	1.75 qu. Mar. 15
Penn-Dixie Cem. com.	4-23-29	22½	22¾	
Penn. Glass Sand Corp. 1st 6's, 1952	4- 3-29	102½	103½	
Penn. Glass Sand pfd.	4- 3-29	110	.....	
Petoskey P. C.	4-23-29	10	10¾	1½% qu.
Riverside P. C. com.	4- 5-29	20	.....	
Riverside P. C. pfd.	4-18-29	.....	21	1.50 qu. May 1
Riverside P. C., A	4-18-29	.....	20	31¼c qu. May 1
Riverside P. C. B	4-18-29	1	.....	
Sandusky Cem.	3-28-29	248	.....	$2 qu. Apr. 1
Santa Cruz P. C. bonds	4-18-29	105¾	.....	6% annual
Santa Cruz P. C. com.	4-18-29	91	.....	$1 qu. Apr. 1
Schumacher Wallboard com.	4-19-29	16⅜	16½	
Schumacher Wallboard pfd.	4-19-29	24	25	
Southwestern P. C. units[44]	4-18-29	270	.....	
Superior P. C., A[20]	4-18-29	44	45½	27½c mo. Mar. 1
Superior P. C., B[26]	4-18-29	28	29	
Trinity P. C. units[37]	4- 5-29	155	.....	
Trinity P. C. com.[37]	4-24-29	55	60	
Trinity P. C. pfd.	4-24-29	99	.....	
U. S. Gypsum com.	4-23-29	61½	62	2% qu. Mar. 31
U. S. Gypsum pt. paid	4-24-29	47¼	.....	
U. S. Gypsum pfd.	4-23-29	125	126	1¾% qu. Mar. 31
Universal G. & L. com.[3]	4-24-29	.....	1	
Universal G. & L. pfd.[3]	4-24-29	.....	10	
Universal G. & L., V.T.C.	4-24-29	no market		
Universal G. & L. 1st 6's[3]	4-24-29	50	60	
Chas. Warner com.	4-22-29	37	41	50c qu. Apr. 15
Chas. Warner pfd.†	4-22-29	110	.....	1¾% qu. Apr. 25
Whitehall Cem. Mfg. com.[36]	4-22-29	150	.....	
Whitehall Cem. Mfg. pfd.[36]	4-22-29	98	.....	
Wisconsin L. & C. 1st 6's[35]	4-24-29	98	.....	
Wolverine P. C. com.	4-23-29	6	6¾	15c qu. May 15
Yosemite P. C., A com.[30]	4-18-29	5	6	

*Ann. inerest due May 1 and Nov. 1. Semi-ann. coupon of $32.50 paid Nov. 1. †First and 2nd pfd. called for redemption at 110, April 25.

[1]Quotations by Watling Lerchen & Hayes Co., Detroit, Mich. [2]Quotations by Bristol & Willet, New York. [3]Quotations by Rogers, Tracy Co., Chicago. [4]Quotations by Butler, Beading & Co., Youngstown, Ohio. [5]Quotations by Freeman, Smith & Camp Co., San Francisco, Calif. [6]Quotations by Frederic H. Hatch & Co., New York. [7]Quotations by F. M. Zeiler & Co., Chicago, Ill. [8]Quotations by Ralph Schneeloch Co., Portland, Ore. [9]Quotations by A. E. White Co., San Francisco, Calif. [10]Quotations by Lee Higginson & Co., Boston and Chicago. [11]Nesbit, Thomson & Co., Montreal, Canada. [12]E. B. Merritt & Co., Inc., Bridgeport, Conn. [13]Peters Trust Co., Omaha, Neb. [14]Second Ward Securities Co., Milwaukee, Wis. [15]Central Trust Co. of Illinois, Chicago. [16]J. S. Wilson, Jr., Co., Baltimore, Md. [17]Chas. W. Scranton & Co., New Haven, Conn. [18]Dean, Witter & Co., Los Angeles, Calif. [19]Hoit, Rose & Troster, New York. [20]Quotations by Bond & Goodwin & Tucker, Inc., San Francisco. [21]Baker, Simonds & Co., Inc., Detroit. [22]Pirnie, Simons and Co., Springfield, Mass. [23]Blair & Co., New York and Chicago. [24]A. B. Leach & Co., Inc., Chicago. [25]Richards & Co., Philadelphia, Penn. [26]Hincks Bros. & Co., Bridgeport, Conn. [27]J. G. White & Co., New York. [28]Mitchell-Hutchins Co., Chicago, Ill. [29]National City Co., Chicago, Ill. [30]Chicago Trust Co., Chicago. [31]McIntyre & Co., New York, N. Y. [32]Hepburn & Co., New York. [33]Boettcher & Co., Denver, Colo. [34]Kidder, Peabody & Co., Boston, Mass. [35]Farnum, Winter & Co., Chicago. [36]Hanson and Hanson, New York. [37]S. F. Holzinger & Co., Milwaukee, Wis. [38]McFetrick & Co., Montreal, Que. [39]Tobey and Kirk, New York. [40]Steiner, Rouse and Stroock, New York. [41]Hornblower & Weeks, New York City and Chicago. [42]E. H. Rollins, Chicago, Ill. [43]Jones, Heward & Co., Montreal, Que. [44]Tenney Williams & Co., Inc., Los Angeles, Calif. [46]Stein Bros. & Boyce. Baltimore, Md. [47]Bank of Pittsburgh, Pittsburgh, Pa. [48]E. W. Hays & Co., Louisville, Ky.

INACTIVE ROCK PRODUCTS SECURITIES (Latest Available Quotations)

Stock	Price bid	Price asked
American Brick Co. pfd. (sand-lime brick) 16 sh.[6]	par 25	25¾
Atlantic Gypsum Products[5] com., 200 shares	$2 per share	.....
Benedict Stone Corp. 1st 7's 1934[8]	.....	86
International Portland Cement Co., Ltd., pfd.	30	45
Knickerbocker Lime Co.[4]	105	.....
River Road Sand and Gravel Co.,[9] 200 shares	$21 per share	.....
River Road Sand and Gravel Co.,[11] 219 shares	$55 per share	.....
Seaboard P. C.[1] 6% bonds ($7,500) 7-1-27. July, 1910, and subsequent coupons attached	$10 for the lot	.....
Southern Phosphate Co.[6]	1¼	.....
Universal Gypsum com. free stk.[1] 300 shares	$75 for the lot	.....
Universal Gypsum com.[1] 153 shares (no par)	$51 for the lot	.....
Vermont Milling Products Co. (slate granules), 22 sh. com. and 12 sh. pfd.[6]	$1 for the lot	.....
Winchester Brick Co., pfd., sand lime brick[5]	10c	.....
Winchester Rock Brick Co. pfd., 1 share (par $25) and 1 share com. (par $10)[6]	$8 for the lot	.....
Winchester Brick Co. pfd.[10] 250 sh. (par $10)	$100 for the lot	.....

[1]Price obtained at auction by Adrian H. Muller & Sons, New York. [2]Price at auction by R. L. Day & Co., December 26, 1928. [4]Price obtained at auction by Barnes and Lofland, Philadelphia, on April 4, 1928. [5]Price obtained at auction for lot of 50 shares by R. L Day & Co., Boston, Mass. [6]Price obtained at auction by Wise, Hobbs and Arnold, Boston, Mass. [8]Auction sales of $1000, Barnes & Lofland, Philadelphia, March 31, 1928. [9]Price obtained at auction by Barnes & Lofland, Sept. 26, 1928. [10]Price at auction Dec. 19, 1928, R. L. Day & Co., Boston, Mass. [11]Price at auction Nov. 21, 1928, by Barnes & Lofland.

Cement Company Comparisons

FRANK H. CREHORE AND CO., investment bankers, New York City, specializing in cement securities, have published another edition of their "Cement" bulletin, the first being that in 1928, which was reprinted, practically in full in ROCK PRODUCTS, May 26, 1928. The present edition brings those data and charts to date, and includes a map showing the location of all the portland cement mills in the United States and a list of them. The charts of the 1929 edition are reproduced herewith:

The following extracts from the bulletin are interesting:

"Most of the foreign cement used by this country is manufactured on a wage scale much lower than that prevailing here and in many cases is transported as ballast for a nominal cost, thereby enabling the European manufacturer to ship across the Atlantic ocean and successfully compete with our mills at their seacoast markets. Almost all cement imported by this country is shipped from Europe to ports in the following states: California, Florida, Georgia, Louisiana, Maine, Maryland, Massachusetts, New York, Oregon, Pennsylvania, Rhode Island, South Carolina, Texas, Virginia, and Washington. During the year 1927, American mills disposed of about 15,000,000 bbl., over 8% of the total American shipments, in these markets at prices representing actual losses ranging as high as

UNITED STATES PORTLAND CEMENT PLANTS
(As of December 31, 1928)

	Number of Plants	Annual Capacity (Barrels)	Percentage of United States Capacity
Lehigh Portland Cement Co.	22	23,700,000	9.96
International Cement Corp.	13*	20,000,000*	8.41
Atlas Portland Cement Co.	8	19,000,000	7.99
Universal Portland Cement Co.	5	17,000,000	7.14
Alpha Portland Cement Co.	10	12,500,000	5.25
Pennsylvania-Dixie Cement Corp.	8	12,200,000	5.13
J. B. John Management	9	10,300,000	4.33
Sandusky Cement Co.			
Petoskey Cement Co.			
Newaygo Portland Cement Co.			
Manitowoc Portland Cement Co.			
Ideal Cement Co.	9	8,250,000	3.46
North American Cement Corp.	3	4,500,000	1.89
Lawrence Portland Cement Co.	2	4,000,000	1.68
All others	70	106,344,000	44.76
Total	159	237,794,000	100.00

*Includes three plants operated outside United States.

MISCELLANEOUS PORTLAND CEMENT PLANTS
(As of December 31, 1928)

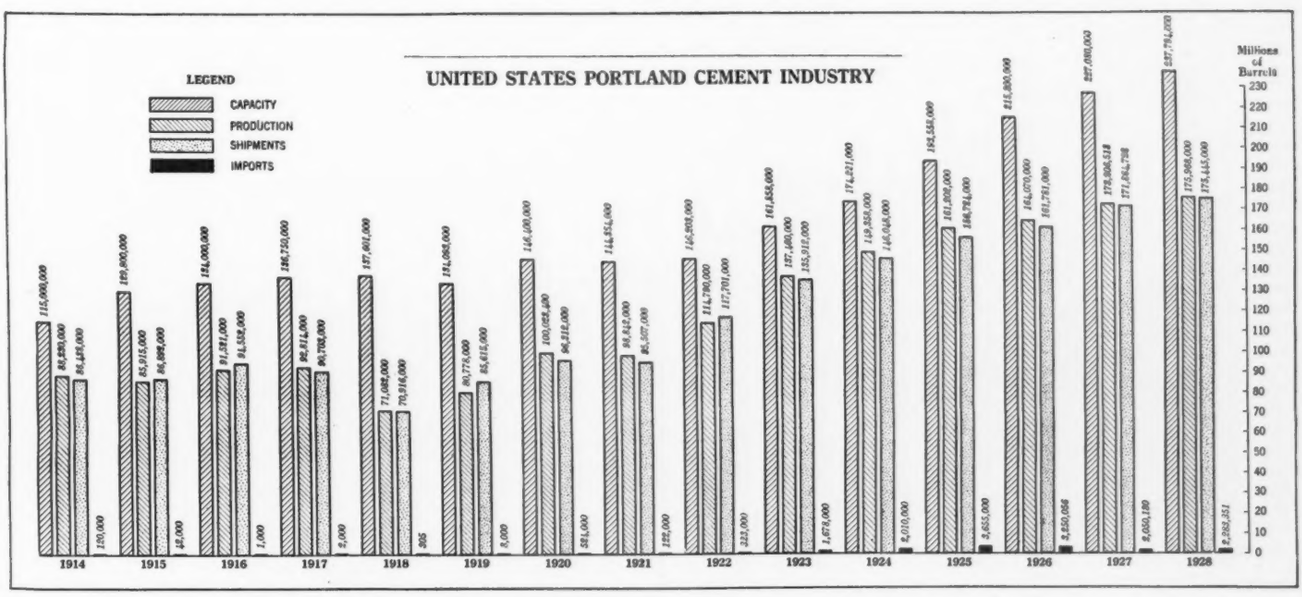
Canada Cement Co., Ltd.	12	12,000,000	.....

Comparative Analysis of Ten Well Known Cement Companies

Company	Property Valuation	Depreciation and/or Depletion	Net Current Assets	Net Worth	Bonded Indebtedness	Preferred Stock Outstanding	Bonds and Preferred Stock	Annual Bond Interest and/or Preferred Dividends	Earnings Applicable to Common	Earned Per Share Common	Common Shares Authorized	Common Shares Issued	Market Value Per Share Common as of 4/1/29	Market Value All Common Shares as of 4/1/29	Market for Common Shares
Lehigh Portland Cement Company (2)	$30,326,320.99	$2,243,532.21	$16,962,337.63	$47,288,658.62	None	$21,696,700.00	$21,696,700.00	$1,518,769.00	$2,608,443.63	$5.79	600,000 (5)	450,348	55	$24,769,140.00	New York Stock Exchange
International Cement Corporation (2)	42,018,591.95	2,442,300.10	8,011,243.62	50,029,835.57	$18,000,000.00	None	18,000,000.00	900,000.00	4,893,012.00	7.90	1,000,000 (6)	618,826	86	53,219,036.00	New York Stock Exchange
The Atlas Portland Cement Company (2)	Not Published	Not Published	Not Published	Not Published	None	2,500,000.00 (4)	2,500,000.00	200,000.00	Not Published	Not Published	1,000,000 (7)	825,000	49	40,425,000.00	Over the Counter
Universal Portland Cement Company (2)	Not Published	Not Published	Not Published	Not Published	Not Published	Not Published	Not Published	Not Published	Not Published	Not Published	Not Published	Not Published	Not Published	Not Published	Subsidiary U.S. Steel Corp.
Alpha Portland Cement Company (2)	22,552,770.59	1,267,539.27	8,903,684.51	31,456,455.10	None	2,000,000.00	2,000,000.00	140,000.00	2,445,534.97	3.44	1,000,000 (6)	711,000	48	34,128,000.00	New York Curb Market
Canada Cement Company, Limited (2)	39,044,695.00	1,598,874.00	4,119,631.00	43,164,326.00	20,000,000.00	21,000,000.00	41,000,000.00	2,465,000.00	29,874.00	.05	750,000 (7)	600,000	30	18,000,000.00	Montreal Stock Exchange
Pennsylvania-Dixie Cement Corporation (2)	26,511,045.98	1,384,784.70	5,302,626.28	31,813,672.26	11,920,000.00	13,588,800.00	25,508,800.00	1,666,416.00	359,732.30	.90	1,000,000 (6)	400,000	18	7,200,000.00	New York Stock Exchange
Ideal Cement Company (3)	17,195,185.74	999,146.59	7,755,969.05	24,951,154.79	8,279,400.00	None	8,279,400.00	413,970.00	2,061,673.34	5.11	600,000 (6)	403,200	78	31,449,600.00	Over the Counter
North American Cement Corporation (3)	13,946,740.75	672,175.37	1,203,224.98	15,149,965.73	7,366,500.00	5,150,000.00	12,516,500.00	837,887.50	Deficit	Deficit	350,000 (6)	133,250	8	1,066,000.00	New York Curb Market
Lawrence Portland Cement Company (2)	9,049,884.40	182,726.38	1,927,278.77	10,977,163.17	2,000,000.00	None	2,000,000.00	110,000.00	721,719.90	9.62	100,000 (7)	75,000	98	7,350,000.00	Over the Counter

LEGEND

1. Annual report for the year ended November 30, 1928 2. Annual report for the year ended December 31, 1928 3. As of 12/31/28 4. Entire issue redeemed March, 1929
5. Par Value $50 6. No Par Value 7. Par Value $100



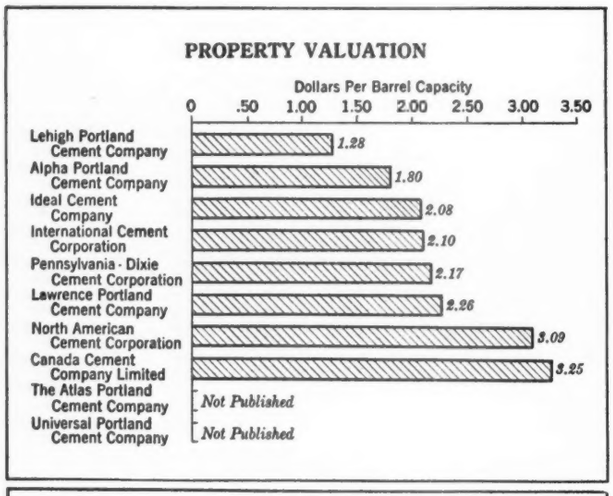
(Text and charts are copyrighted by Frank H. Crehore and Co., New York City)

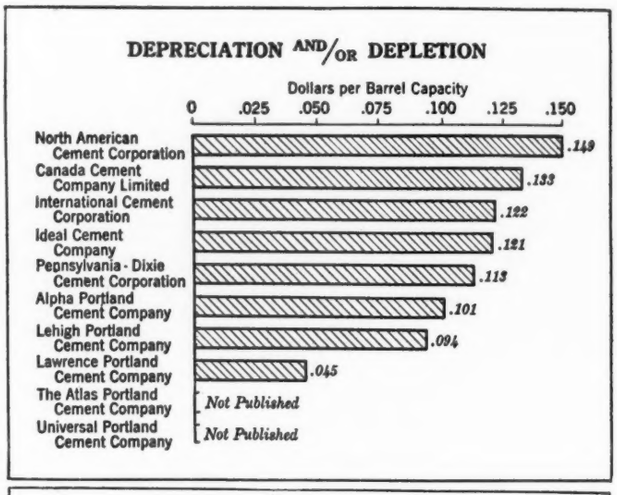
62c. a barrel. These markets are the stronghold of the American industry and consume about 40% of its production.

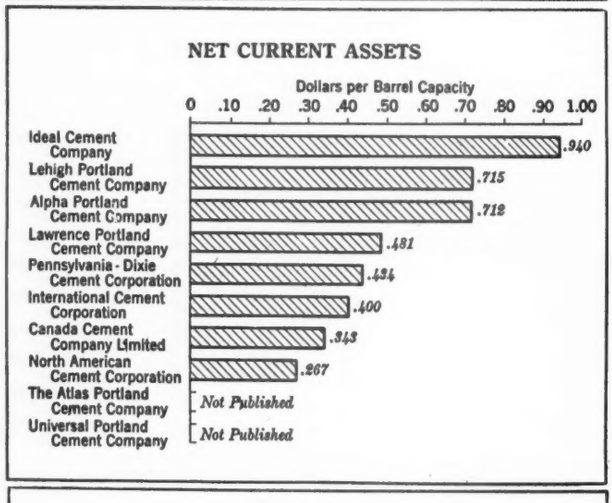
"It is presumed that the present Administration realizes this unfair condition and will remedy it by removing cement from the free list and granting our manufacturers a suitable protective tariff, thereby equalizing the difference of production and transportation costs between the foreign and domestic products.

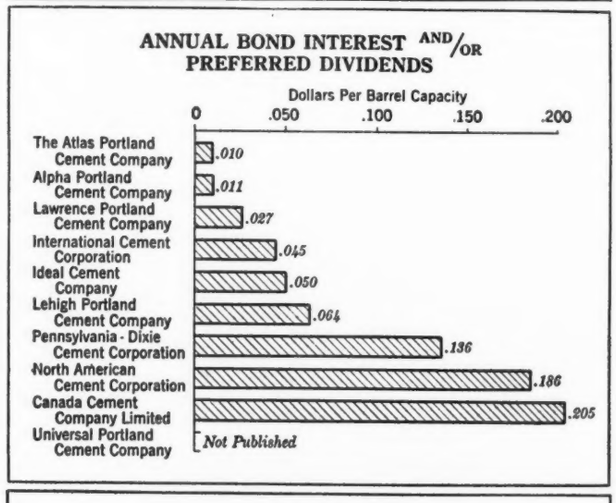
"While earnings of cement companies have reflected the conditions arising from the influence of foreign cement, there is now promise of improvement through the stabilization of their marketing conditions. During this present period of adjustment, cement securities are available at unusual investment values. The senior securities of conservatively capitalized companies are reasonably priced, sound, industrial investments, and the common stocks of such companies offer great possibilities for enhancement in value during the next few years.

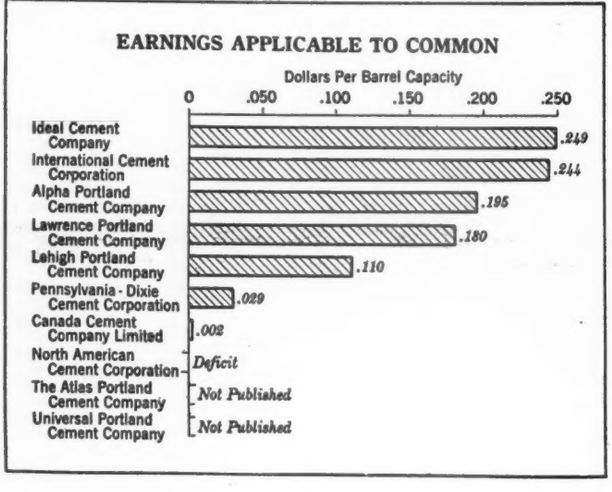
"Quite generally, the companies in this industry are well managed. Therefore, the investor in the securities of a cement company should consider, in addition to earnings, the amount of its capitalization per barrel of capacity. He should also consider the location of its plants; both from the standpoint of supply of raw materials and from the accessibility of markets for the finished product. These considerations should be emphasized most when choosing the securities of a new company that is attempting to enter this field."

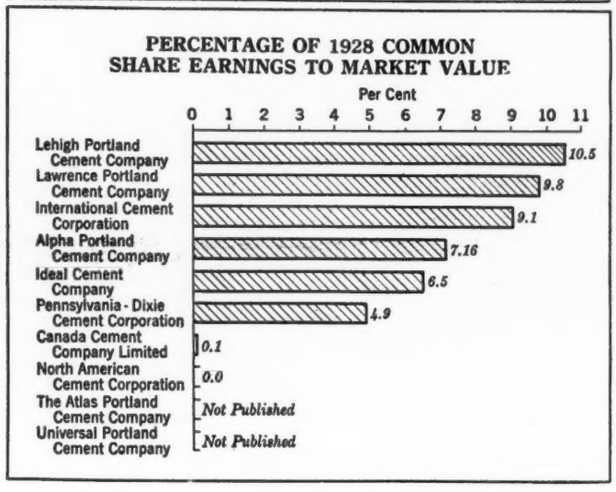

PROPERTY VALUATION
Dollars Per Barrel Capacity
0 .50 1.00 1.50 2.00 2.50 3.00 3.50
Lehigh Portland Cement Company 1.28
Alpha Portland Cement Company 1.80
Ideal Cement Company 2.08
International Cement Corporation 2.10
Pennsylvania-Dixie Cement Corporation 2.17
Lawrence Portland Cement Company 2.26
North American Cement Corporation 3.09
Canada Cement Company Limited 3.25
The Atlas Portland Cement Company Not Published
Universal Portland Cement Company Not Published


DEPRECIATION AND/OR DEPLETION
Dollars per Barrel Capacity
0 .025 .050 .075 .100 .125 .150
North American Cement Corporation .149
Canada Cement Company Limited .133
International Cement Corporation .122
Ideal Cement Company .121
Pennsylvania-Dixie Cement Corporation .113
Alpha Portland Cement Company .101
Lehigh Portland Cement Company .094
Lawrence Portland Cement Company .045
The Atlas Portland Cement Company Not Published
Universal Portland Cement Company Not Published


NET CURRENT ASSETS
Dollars per Barrel Capacity
0 .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00
Ideal Cement Company .940
Lehigh Portland Cement Company .715
Alpha Portland Cement Company .712
Lawrence Portland Cement Company .481
Pennsylvania-Dixie Cement Corporation .434
International Cement Corporation .400
Canada Cement Company Limited .343
North American Cement Corporation .267
The Atlas Portland Cement Company Not Published
Universal Portland Cement Company Not Published


ANNUAL BOND INTEREST AND/OR PREFERRED DIVIDENDS
Dollars Per Barrel Capacity
0 .050 .100 .150 .200
The Atlas Portland Cement Company .010
Alpha Portland Cement Company .011
Lawrence Portland Cement Company .027
International Cement Corporation .045
Ideal Cement Company .050
Lehigh Portland Cement Company .064
Pennsylvania-Dixie Cement Corporation .136
North American Cement Corporation .186
Canada Cement Company Limited .205
Universal Portland Cement Company Not Published


EARNINGS APPLICABLE TO COMMON
Dollars Per Barrel Capacity
0 .050 .100 .150 .200 .250
Ideal Cement Company .249
International Cement Corporation .244
Alpha Portland Cement Company .195
Lawrence Portland Cement Company .180
Lehigh Portland Cement Company .110
Pennsylvania-Dixie Cement Corporation .029
Canada Cement Company Limited .002
North American Cement Corporation Deficit
The Atlas Portland Cement Company Not Published
Universal Portland Cement Company Not Published


PERCENTAGE OF 1928 COMMON SHARE EARNINGS TO MARKET VALUE
Per Cent
0 1 2 3 4 5 6 7 8 9 10 11
Lehigh Portland Cement Company 10.5
Lawrence Portland Cement Company 9.8
International Cement Corporation 9.1
Alpha Portland Cement Company 7.16
Ideal Cement Company 6.5
Pennsylvania-Dixie Cement Corporation 4.9
Canada Cement Company Limited 0.1
North American Cement Corporation 0.0
The Atlas Portland Cement Company Not Published
Universal Portland Cement Company Not Published

Discussion of Trade Association Codes Is Planned

AROUND-TABLE DISCUSSION of trade practice conferences will be held in connection with the seventeenth annual meeting of the Chamber of Commerce of the United States at Washington, April 29 to May 3.

The development of the trade practice conference movement, as a means of promoting self-regulation of business, is followed with great interest by all lines of industry, and is supported actively by the National Chamber. The round-table will afford an unusual opportunity for a full discussion of the movement and its place in industry.

"The National Chamber's interest in trade practice conferences," it is announced, "is a logical development of the position taken by it for self-regulation by business and the development and use by trade associations of sound codes of business practice.

"A continuation of wasteful and harmful practices making for unfair competition and of practices that are uneconomic and unbusinesslike is putting such a serious burden upon business that more than 100 industries, through their associations, have either gone through a trade practice conference or are preparing for such a conference."

Representatives of a number of these industries will attend the round-table and take part in the discussion in the light of their experiences with trade practice conference. In order to facilitate the discussion, which will be informal in character, the following questions relating to trade practice conferences have been listed for consideration:

Eliminating unfair or uneconomic business practices through conferences:

(a) Has the adoption of codes of business practice by industry been effective in securing the results desired?

(b) What practices may be eliminated through a conference?

Promotion of improved business practices:

(a) Can an industry which has no trade association adopt and administer a program for improved trade relations?

(b) What procedure have trade associations found most satisfactory in preparing an industry for a conference?

Preparation for a trade practice conference:

(a) What preliminary work is necessary to provide sound basis for conference?

(b) Is the conference covering the vertical set-up of an industry a practical one?

(c) May a separate section or part of an industry prepare effectively for a conference?

Enforcement of agreements:

(a) May an industry set up machinery to secure observance of conference rules?

(b) What results are being secured in the enforcement of agreement resulting from conference?

(c) How far should an industry go in accepting responsibility for policing of an agreement?

Federal law in relation to the trade practice conference:

(a) How far do state anti-trust laws apply to agreements concluded at trade practice conferences?

(b) Is additional statutory authorization necessary to the effectiveness of a conference?

(c) In formulating rules for a trade practice conference to what extent are the conferees under obligation to pass upon the soundness of such rules from the viewpoint of Federal Law?

New Cement Mill Contemplated at Vancouver, B. C.

PRELIMINARY investigation by experts having been highly favorable, Seattle capitalists are contemplating the early construction of a cement mill at Vancouver, British Columbia, it was recently announced. The project is to cost approximately $1,500,000. It is reported that the capitalists behind the project are those operating portland cement mills in the United States. Some local capital may be included, it is said.

The proposed plant would have an annual capacity of 300,000 bbl. or approximately 1000 bbl. daily and would be furnished with supplies from property already designated at Popkum, 17 miles east of New Westminster on the Canadian National railway. The Popkum property covers approximately 400 acres and a spur line has already been built into it, it is said.

Site of the plant has not yet been selected, those interested considering areas at New Westminster, Marpole and North Vancouver. It is declared possible that materials from Popkum may be had via the Fraser river.—*Vancouver* (B. C.) *Evening Star.*

Ash Grove Plant at Louisville, Neb., Ready to Operate

MACHINERY of the new $2,000,000 cement plant at Louisville, Neb., operated by the Ash Grove Lime and Cement Co., of which L. T. Sunderland, Kansas City, is president, had its initial tryout on April 12. J. A. Sunderland of Omaha is vice-president. One of the large rotary kilns was fired for the first time. Everything worked to the satisfaction of the company.

The formal opening will take place in the near future. The plant will be operated winter and summer, employing between 200 and 300 men. All vacant houses in Louisville have been rented or bought and many new ones are being erected, yet the demand far exceeds the supply.—*Omaha* (Neb.) *World-Herald.*

Twelfth Exposition of Chemical Industries

THE Twelfth Annual Exposition of the Chemical Industries will be held at the Grand Central Palace, New York City, from May 6 to 11, inclusive, and an attendance of manufacturing executives, chemists, chemical engineers, etc., exceeding in numbers that of last year is expected.

Exhibits of raw materials and finished products which find application in the arts, science and industry will be shown, as well as that which is new and interesting in the line of new machinery and equipment. At the professional sessions student classes will be held to give instructions on the fundamentals of industrial and chemical engineering practices. Other programs of addresses will be given covering the chemical field. Papers that probably will be of interest to ROCK PRODUCTS readers are those that will be delivered relative to disintegration, grinding, dust collection, filtration and control.

Milwaukee County, Wisconsin, Gravel Producers Form Selling Association

SAND, GRAVEL AND CRUSHED STONE dealers and producers in Milwaukee county, Wisconsin, 20 concerns operating 30 separate yards, have organized the Mineral Aggregate Co-operative Association. The organization is formed under the state marketing law. A central office has been opened at 317 Empire building, Milwaukee. All orders will be received here and the business will be distributed to the yards best located to supply the material.

Officers of the association are: President, J. K. Jensen, president Janesville Sand and Gravel Co.; vice-president, Herbert Froemming, Froemming Brothers; secretary, A. J. Blair, secretary-treasurer Lake Shore Sand and Stone Co.; treasurer, Charles Schloegel, Central Sand and Gravel Co.; general manager, M. W. Deutsche.

"Through the central organization we will look after credits better," said Mr. Deutsche. "Loose credit methods have been a serious handicap to the industry. Distribution of orders to yards located nearest the job will also save many long hauls. It has been common for yards at the north end of the city to haul material across the city to the south side while at the same time a south side yard was making hauls to the north side. This will be avoided.

"Orders will be filled more promptly. The dealers have found that it will be better to work together. Control of prices is not planned. This is impossible as there are independent yards and more may be opened."

There are from 2,500,000 to 3,000,000 tons of sand, gravel and crushed stone used annually in Milwaukee in the paving and building business, Mr. Deutsche estimates.—*Milwaukee* (Wis.) *Journal.*

Foreign Abstracts and Patent Review

Bauxite Cements—W. Obst reviews the literature respective to the history of bauxite for cement production, some processes of making bauxite cement and various plans for the utilization of bauxite.—*Zement* (1929), **184,** pp. 98-99.

Cracking of Glass Plates by Standard Cement Samples—Dr. F. Schott presented the results of his investigations into the causes of the cracking of glass plates when standard cement samples, particularly in water storage, adhere to them, at the 51st general meeting of the Society of German Portland Cement Manufacturers at Berlin on March 14, 1928. The results of many varied tests with different cements and different grades of glass are described and illustrated with 25 illustrations.—*Zement* (1928) **17,** 30, pp. 1134-37, 31, pp. 1169-72.

Action of Pure Water on Different Hydraulic Binders—Pierre Dumolard contributes some notes to the article on "Action de l'eau pure sur les differents liants hydrauliques" (November, 1927, issue), stating also that the specific resistance of early strength cement is superior to that of portland cement for the following reason: If the decomposition is done by solution of its hydrated lime in pure water, a cement resists the better the slower the rate of solution; returning to the experiences of Candlot, we see that portland cements treated with pure water loose in a month a third of their lime content, whereas early strength cement, under the same condition, loses only ⅕ as much.—*Revue des Materiaux de Construction et de Travaux Publics* (1928) 224, pp. 165-6.

The Magnesia Cements—First it is reported concerning Sorel cement, whereby the following hydratation products are given: (According to Bendes) $5MgO \cdot MgCl_2 \cdot 17H_2O$; (according to Krause) $MgOH \cdot Cl_4 \cdot Mg(OH)_2 \cdot 5H_2O$; (according to Thoff) $5MgO \cdot MgCl_2 \cdot 14H_2O$; (according to Davis) $5MgO \cdot MgCl_2 \cdot 13H_2O$. Then the individual methods, according to which magnesia is isolated from dolomite, are described. The first consists in the action of Mg salts upon dolomite and is based upon the reaction in which the lime replaces the magnesium in its salts. Especially by the action of calcined dolomite upon $MgCl_2$ the entire lime enters into solution and liberates MgO. Another method concerns the slaking of burned dolomite with water and a following treatment with acid, whereby the lime is fixed, whereas the magnesia as a weaker base remains as hydrate. The Rombacher blast furnace plant operates according to the method in which acid treatment starts in after burning of the dolomite, until the complete expulsion of CO_2, which creates a soluble lime salt removable by washing. The Rheinish-Westphalian lime works, using the process of the Hungarian Soma Gelleri, burns dolomite moderately and treats the material then with alkaline carbonate, or bicarbonates in the presence of CO_2 at a temperature between 60 and 70 deg. C., when the magnesia enters into solution, but the lime precipitates as $CaCO_3$. The dissolved magnesia salt $KMgH(CO_2)_2 \cdot 4H_2O$ disintegrates at 100 deg. C. to $MgCO_3$. Finally there exists a process, in which the burned dolomite is treated with sugar for the formation of a soluble lime saccharin.—*Revue des Materiaux de Construction et de Travaux Publics* (1928) 223, pp. 142-143.

Progress Realized in the Manufacture of Limes and Cements and Their Influence on the Execution of Masonry—J. Bolomey, Lausanne, presents a general discussion of the historical economical and chemical developments in the lime and cement manufacturing and consumption industry from ancient times to date. *Ciment* (1928) **33,** 8, pp. 323-328.

The Manufacture of Plaster and Its Control—L. Chassevent describes the recent introduction of mechanical plaster manufacturing equipment in France and the successful endeavors to overcome the defects of the new equipment as compared to old methods, and he emphasizes the importance of controlling the entire manufacturing process by aid of chemical analyses and their comparison to aid in improving the process.—*Revue des Materiaux de Construction et de Travaux Publics* (1928) 228, pp. 337-339. Same article in *Ciment* (1928) **33,** 7, pp. 267-8.

New Facts Concerning the Disintegration of Certain Concretes of Alumina Cement—E. Freyssinet and A. Coyne deal with this subject, to which their opponent in this matter, Feret, appends some paragraphs, which adds some further interesting data to previous articles on this subject (*see Genie Civil* (1928), *March 3,* 12).—*Genie Civil* (1928) **93,** 6, pp. 140-143.

Influence of the Quantity of Water in Motar Upon the Quality of Concrete—E. Freyssinet has made an extensive scientific study of this subject, from the viewpoint of the engineer user.—*Genie Civil* (1928) **93,** 3, pp. 60-63.

New Researches on the Alumina Cements—R. Feret delivered a paper at the meeting of February 12, 1927, of the French-Belgian Association for Testing Materials, in which he presented the results of some researches undertaken for the purpose of clarifying certain anomalies of hardening and of coloration of concrete made with a similar cement observed in the field, and Freyssinet and Coyne, on the other hand, explained these phenomena which they considered as a sign of disintegration from an excessive temperature of the materials at the time of mixing the mortar. Then followed Le Chatelier's account of the studies on the chemical, thermic and mechanical actions which prove or accompany the hardening of cements. None of these papers appearing very conclusive in respect to the explanation of the anomalies observed, so R. Feret supplemented the researches with the results obtained in making eight series of tests for different purposes with four alumina cements from three different sources, presenting the paper at the December 19, 1927, meetings of the association. The seven elaborate tables and five diagrams give the chemical compositions of the alumina cements used, results of the normal tests, influence of adding fresh water and sea water in preparing the mortar, influence upon strengths of time passed before taking mortar to site, influence upon strengths of the initial conditions in storage of samples, as temperatures, etc., and two extensive tables on the various influences such as fresh or sea water, temperature of aggregates, storage of samples for different periods under different temperatures in water or in air under a constant humidity, upon the compressive and tensile strengths of concretes in plastic, soft and fluid conditions prepared with ordinary cement, high resistance portland cement and the four alumina cements.—*Revue des Materiaux de Construction et de Travaux Publics* (1928) 223, pp. 136-138; 224, pp. 166-171.

Rapid Method for Determining Iron in Hydraulic Cements—Gelber points to the necessity of determining iron in the pulverized raw material and clinker, though it concerns always very small quantities which, however, nevertheless can exert a great influence upon the quality of the product. The principle of the method consists in this, to mix the hydrochloric acid solution with ferrous chloride for the reduction of the iron and to pass the excess of $FeCl_2$ by means of mercuric chloride into ferric chloride. Manganese sulphate is added further to prevent oxidation of the hydrochloric acid by permanganate; phosphoric acid to prevent self-coloring of the solution through iron salts and sulphuric acid to dissolve the MnO_2 discarded from the permanganate. Then it is titrated with $\frac{n}{10}$ potassium permanganate until the red coloring lasts for a few seconds. The entire op-

erations can be carried through in 10 to 20 minutes.—*Revue des Materiaux de Construction et de Travaux Publics* (1928) 224, pp. 161-162.

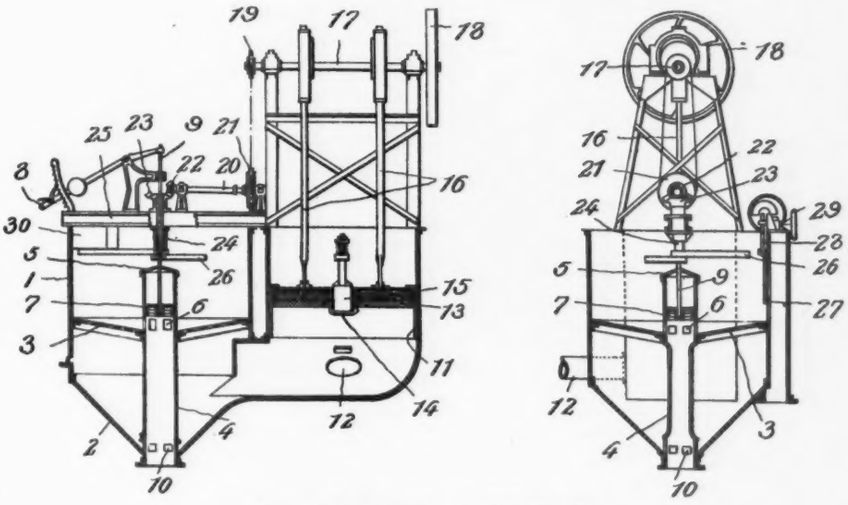
The Cement Works in Origny-Sainte Benoite—The new works work chalk obtained in surface mining. The monthly coal consumption is 6,000 metric tons under full operation. The machinery equipment of the two plants was furnished by the Danish firm F. L. Smidth and Co. and the German firm Krupp. The three rotary kilns in the plant A are each 45m. (148 ft.) long, whereas the rotary kiln in plant B has a length of 75m. (246 ft.) and a diameter of 3 m. (9.8 ft.). At an annual capacity of 250,00 metric tons, up to 1500 tons can be shipped daily.—*Revue des Materiaux et de Construction et de Traveaux Publics* (1928) 223, pp. 121-135.

Recent Process Patents

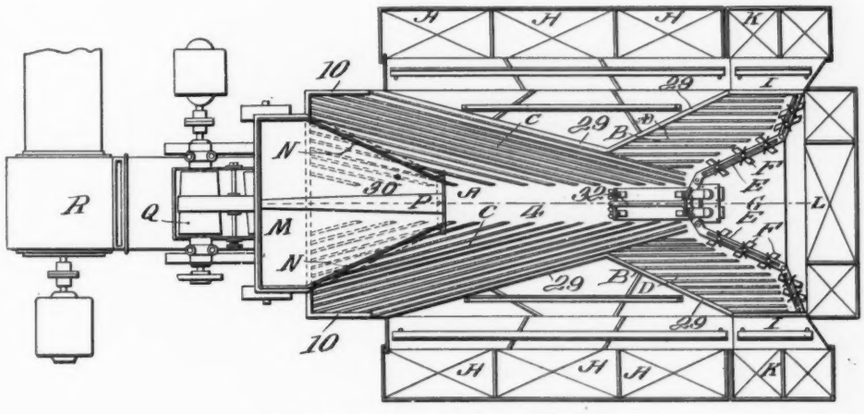
The following brief abstracts are of current process patents issued by the U. S. Patent Office, Washington D. C. Complete copies may be obtained by sending 10c to the Superintendent of Documents, Governmen Printing Office, Washington, for each patent desired.

Dry Separating Table—A recent invention employs a reciprocating table of Y-shape with riffles and a deck of pervious material over an air chamber. Air rising through the permeable deck stratifies the materials, the heavier particles working along in the riffles by the reciprocating motion of the table while the lighter materials above are carried across the table by cross currents of air. There are ingenious details showing how the force of the current is automatically regulated to the depth of the material with which it has to contend and other features, the patent being on improvements to the basic patent for this type of table, No. 530,357, filed January 19, 1922. (The inventors of this machine have invented and built several similar machines which have been used commercially in cleaning coal, metallic ores, and grains and seeds. In the rock products field they have been successful experimentally in cleaning phosphate rock and glass sand. Working on sized products it is said that this machine will clean coal crushed as fine as 100-mesh. Editor.)—*Sutton, Steele and Steele.* January 15, 1929. U. S. Patent No. 1,699,382.

Jig—Jigs have a somewhat limited use in the rock products field for washing barytes and removing shale, coal and lignite from gravel and trash and clay balls from gravel and crushed stone. A new form of Japanese origin has been especially designed for cleaning coal but could be used for the purposes just mentioned. Its main feature is the method of discharging the coal or other top-material, which in other types is usually floated off by a current of water. In this type it is removed by a scraper on a vertical shaft, and the scraper is curved so as to work the coal to a port in the outside wall. The heavy materials are discharged through ports in a central pipe and all the discharge ports have means for regulating the size of the opening. The jig is a single cell machine and the chamber in which the separation is made is cylindrical, which, the inventor says, insures a more even distribution of pressure than is found in other forms. The piston which makes the pulsations of the water has the usual arrangements for varying the length of the stroke and the amount of pulsion and suction.—*C. Natkatsu.* February 12, 1929. U. S. Patent No. 1,701,589.



New jig for hydraulic classification



Dry separating table with riffles

Foreign News Notes

THE Sillein Ledecer Portland Cement Works is to erect a new cement plant in Czechoslovakia.

The production in the large cement plants of Galicia and Congress Poland has been increasing monthly due to increased domestic demand and increased export to foreign countries, particularly Greece, Roumania, North Africa and Brazil, brought about by the Polish export syndicate organized about a year ago.

During the last two years the demand for cement in Chile has doubled, of which about 14,410 tons per month can be supplied by the domestic plants. The importers are, in order of importance, Germany with 60% of the total imported cement, Great Britain and Belgium, the consumption reaching 130,000 tons per year at the close of 1927.

The Russian government is erecting a new cement plant near Tiflis, the equipment supplied by the Danish firm F. L. Smidth and Co.

The Nowoross Cement Trust is completely rebuilding the old cement plant at Haiduk near Rostow on the Don at a cost of 2,500,000 rubels and will produce principally high grade alumina cement.

The Societe des Chaux et Ciments du Senegal has been founded in Dakar with a capital of 5,000,000 francs for the production of limes and cements.

Heavy Japanese competition has reduced the cement prices in Dutch India, according to the Nederl. Ind. Portland Cement Mij.

Albany Safety Meeting of Portland Cement Industry Most Successful

ONE OF THE MOST INTERESTING and successful of the present series of regional safety meetings by the Portland Cement Association was held in Hotel Ten Eyck, Albany, N. Y., on Tuesday, April 16. In attendance and interest the meeting was an even more pronounced success than the similar occasion held in Albany last year.

Charles S. Andres, superintendent of the Lone Star Cement Co., New York, at Hudson, acted as chairman with Charles S. Parks, treasurer of the North American Cement Corp., and H. A. Ross, treasurer of the Lone Star Cement Co., New York, assisting on the local committee on arrangements. Every mill in the eastern New York area was well represented.

The program was as follows:

MORNING SESSION

REPORT OF SAFETY WORK IN THE CEMENT INDUSTRY IN 1928.
A. J. R. Curtis, assistant to general manager, Portland Cement Association.

INDUSTRIAL HYGIENE.
John N. McDowell, division of industrial hygiene, New York State Department of Labor.

MATERIAL HANDLING.
H. W. Gabor, safety engineer, New York State Insurance Fund.

ACCIDENT PREVENTION AND JOB SAFETY.
F. W. Kelley, president, North American Cement Corp.

NEW IDEAS.
J. D. Harnden, assistant manager, General Electric Co., Schenectady, N. Y.

LUNCHEON

Luncheon Chairman, R. B. Fortuin, assistant to general manager, Pennsylvania-Dixie Cement Corp., Nazareth, Penn.

Luncheon address, Col. E. C. Spring, Lehigh Valley Transit Co., Allentown, Penn.

AFTERNOON SESSION

FIRST-AID TEAM WORK.
R. D. Currie, United States Bureau of Mines.

FIRST-AID COMPETITION.
Judge: R. D. Currie, United States Bureau of Mines.

ROUND TABLE DISCUSSION.
By everybody. Opened by A. G. Beck, superintendent, Canada Cement Co., Ltd., Montreal, Que.

DINNER

D. P. Cooper, vice-president, Lone Star Cement Co., New York, toastmaster.

Address by Dr. R. M. Little, New York State Department of Education.

Music by Albany String Ensemble.

Recent Record Pleases

Discussion of the safety record of the mills represented with that of the entire group within the membership of the Portland Cement Association, which was the opening subject, showed notable improvement by the local mills. The number of lost-time injuries suffered by the eastern New York mills decreased from 215 or 43 per mill reporting in 1924, to 34, or 4.8 per mill reporting in 1928, whereas the decrease over the entire association membership was from 30 accidents per mill in 1924 to 7 per mill in 1928. The individual records of the plants in this local group over the above period is shown in an accompanying diagram.

Importance of Hygiene Stressed

Those present were indeed fortunate in listening to the paper on industrial hygiene presented by John N. McDowell in charge of this work for the New York state department of labor. Mr. McDowell said, in part:

"The general conception of industrial hygiene by the profession is that it relates to the worker in some way but principally with reference to washrooms, toilets, light, air and prevention of diseases caused by harmful substances used in or manufactured in factories. Industrial hygiene is much broader in scope and cannot be said to be limited entirely to factory conditions. It concerns not only the factory worker but all those engaged in occupations and in addition all conditions directly or indirectly surrounding or relating to the occupation.

Charles S. Andres

"Industrial hygiene maintains the same relation to the industry as does the physician to his patient.

"The following are questions that must be answered:

"Is a given industry a health menace?

"What is the underlying cause?

"What is the diagnosis and cure?

"Can it affect others?

"To answer these questions requires an examination before a diagnosis can be made and curative measures prescribed. The examination includes inspection and investigation of the process of manufacture, which comprises the action of machinery and also a physical examination of the workers engaged. There is also required an analytical study of air conditions and substances used just as clinical microscoping and laboratory analysis are necessary for diagnosis in the practice of medicine. Not the least is the study of the relation of the machinery and guarding thereof to the health as well as to the safety of the worker. In other words the following procedure as used in medicine must follow in solving problems of industrial hygiene. There must be studies of:

"*Predisposing cause*—Process of manufacture and materials used or produced.

"*Exciting cause*—Operations, hand or machine including safety appliances attached thereto and conditions under which they are carried on.

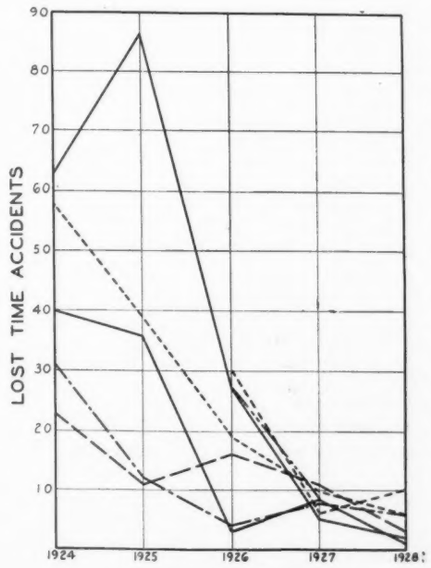
"*Diagnosis*—The harmful results upon the human economy.

"*Treatment*—Recommendations as to installation of curative means: (First) for the industry; proper air conditioning; proper illumination; proper safeguards; proper toilets, washrooms and water supply; (second) the worker; protective clothing and other safeguards to be worn; (third) general; education and welfare provisions are also important; (fourth) the public health; protection for those indirectly exposed and control of harmful substances after removal from the place where process is carried on.

"It must be apparent then that industrial hygiene is no small subject; and to efficiently apply the results of investigations to best advantage requires more than a mere knowledge of medicine, sanitation or even mechanics; and in addition it must be closely connected with the agency empowered to enforce laws and codes dealing with industrial processes. The professions of medicine, chemistry and engineering are closely allied in the applications of industrial hygiene.

"The factors governing health accidents are, so far as industry is concerned, machinery, lighting, air conditioning and sanitary conveniences, together with water supply and facilities for washing. But the factors within industry are not alone responsible for accidents so far as the individual worker is concerned. Sickness attributable to the hazards of industry, or to the individual's occupation, has been variously described as occupational diseases, industrial diseases and industrial poisonings. Within the meaning of the various compensation acts these must be considered as accidents in order to make a claim for an award.

"Death or serious injury occurring as a result of machinery or automobile accident is a hazard the average person readily understands, because it is one that can be visualized, and so the people lend their united efforts to the enactment of safety measures. Harmful substances or unsanitary conditions are hazards that even professional and technically trained individuals fail to recognize as a serious menace, and thus the general public does not give these things the marked attention or support accorded to conditions likely to result in accidental bodily injury.



Lost-time accident records of the various mills in the Eastern New York District

Industrial Hygiene a Broad Science

"Industrial hygiene then is that science which relates to the study of industry and the effect of its conduct upon the health and safety of its operators; all this to the end that normal human life is prolonged and production increased without hardship or economic loss. Industrial hygiene is that microscope under which the statistics of compensation should be placed for dissection and search to ascertain the remote reason for the accident, for surely there is always a remote cause even though not readily perceptible. We may find that directly or indirectly some established principle of industrial hygiene has been violated.

"Eye injuries and falling objects seem to account for the larger proportion of accidents in the cement industry. These injuries to the eyes are practically all entirely preventable by the wearing of suitable goggles. It is not an unusual sight to find men working who have already lost the sight of one eye refusing to wear goggles.

"In dealing with the hazard of falling objects there is much to be said about the education of the employe. For instance, the unloading of raw material and the handling of frozen material in winter increases the hazard. Men working in the raw material building at the opening in the bin are often subjected to many hazards, one of the commonest being that of large lumps of frozen material rolling out of the bin and perhaps bruising their feet or legs. It is also necessary for workmen at times to enter these bins and there they encounter the hazard of undetermined material. Falls of material may occur at any time and this hazard should not be overlooked. The wearing of torn clothing, flowing neckties, loose sleeves and the use of gloves constitutes other hazards.

"The faculty of reasoning or thinking is one which may as you know be developed in several ways. For the workman who is provided with a foundation of learning coupled with brains there is great promise. For the worker who has to learn by bitter and sometimes tragic experience the road is long and difficult and beset with dangers. For the worker who is well trained in discipline the matter of reasoning is not so vital.

"There is another factor which enters into the cause of accidents, and it comes within the province of reason, and that is selfishness. This is also a question of mentality or mental balance. By selfishness I mean consideration of ourselves alone with no thought of what our activities may do to others. A careless workman throws a hammer on the floor where it hits a discarded nail which flies into the eyes of another worker.

"Again, there is that type of accident which occurs as the result of improper mental balance in the worker who has control of mobile machinery. He is a danger to workers in his path when the worker allows his thoughts to wander to a poker game or a picnic in the woods; he has eyes and ears but he sees not, neither does he hear; and a man's life may be the penalty.

"One industry by its nature requires good eyesight in the workers; another requires substantial physique with normal heart and lungs; still another requires that women be employed instead of men; yet another requires that all shall be neat and clean in their personal habits. But such requirements rigidly adhered to are not the rule.

"It is strange that after an accident or occupational disease occurs, it is easily found by some physician that the man had defective eyesight or deafness, or could not distinguish colors, or was not sensitive to odors, or was alcoholic, or had a four plus Wasserman. These abnormal conditions were found only after the accident occurred. The study of the abolishment of typhoid fever, malaria, diptheria, smallpox, tuberculosis and other communicable diseases is known as preventive medicine and is the goal of all forward-looking people today. So also must the study of the abolition of amputated fingers, arms, legs, hands and scalps constitute an objective of industrial hygiene. Similarly, harmless ingredients in manufacture should be sought to replace the harmful substances. Industry has already proven this can be accomplished. The aim should be to remove if possible the cause; and where that cannot be done to supply protection to the workers.

"Periodical examination offers the best control so far as health accidents are concerned. Every one should be acquainted with his physical condition as a protection to himself and his family. It is likewise a duty to our country to maintain the highest degree of man power. In some industries the law requires a medical examination of the workers. A physical examination would reveal whether a worker was physically able to follow a given occupation and would do much to lengthen the span of life. We should encourage the return of the family physician. No one should know the human mechanism better than he who brings it into the world and sees it develop. We should encourage him.

"Those of us who are familiar with the good book know there is described somewhere in it, the building of a great temple where thousands of workers were employed. It took many years to complete. There must have been co-operation of the highest degree in forest, in the quarry and in the shop; for it is recorded while this building was in progress there was not heard either sound of ax, hammer or other tools. It was a temple set on a high hill above the city of Jerusalem and it was a temple dedicated to the worship of God.

"It seems to me we are engaged in the building of a great structure. We know that there is a sure co-operation on the part of all those who are working in the field. We know that with quietness and sureness and without noise, it is going forward steadily and so rapidly that we do not realize the progress it is making. Its foundation has been laid in a great and costly need. the building is being composed today of energy, zeal, loyalty, interest, intelligent service of brain, hand and heart. The walls are being covered with kindness, courtesy, consideration and thoughtfulness. But above all, the walls inside and out are being overlaid with the pure gold of humanitarianism and brotherly love. This should be when completed a wonderful structure, a temple dedicated to the preservation of human life and limb and the elimination of waste and suffering and sorrow."

John N. McDowell

Following Mr. McDowell's paper on industrial hygiene, H. W. Gabor, who has had twenty years' experience inspecting cement plants in the course of his duties as safety inspector for the New York State Insurance Fund, presented a masterful dis-

cussion of material handling hazards. Mr. Gabor impressed his audience with his vast amount of accurate detail information about cement-mill conditions. His paper will appear in full in a later issue of ROCK PRODUCTS.

F. W. Kelley Speaks

F. W. Kelley, president of the North American Cement Corp., spoke extemporaneously on the value of more careful study

Frederick W. Kelley

of our accidents in order to watch more carefully the present trend toward greater severity. Mr. Kelley pleaded for more completeness and accuracy in accident reports by the plants in order to supply the Portland Cement Association with information greatly needed in attacking the problem. Mr. Kelley also diverged from the subject of accident prevention long enough to give the men an insight into the necessity for a tariff on foreign cement, as "job safety" for American workmen. He told of the recent diligent efforts of the executives to interest the federal tariff commission in the situation and of his hopes that help would be given soon.

Following Mr. Kelley, J. D. Harnden, assistant manager of the General Electric Co., Schnectady, told of the contribution of electrical research work to the cause of safety, enumerating fifty new safety ideas either in use by General Electric Co. workmen or available as the result of recent research.

Col. Spring Speaks at Luncheon

Col. E. C. Spring, president of the Lehigh Valley Safety Council and safety director of the Lehigh Valley Transit Co., of Allentown, Penn., brought a most interesting and enthusiastic luncheon message. Col. Spring, who is known as one of the leading safety organizers and speakers of America, paid high tribute to the accident prevention work of the portland cement industry and spoke of the power that is put into the hands of the workers as they develop the ability to control it by practicing safety. Col. Spring said in part:

"In accepting your very kind invitation to be your guest today, I bring you greetings from the great valley of Lehigh that produces 20% of the entire output of your industry. I am mindful that the interests represented here today are closely allied to our great valley and with you I am very much at ease, but I shall not speak to you in the vernacular of the Pennsylvania German, but in the mother tongue.

"It seems like 'bringing coal to New Castle' for me to talk on the safeguarding of human life and property to such an outstanding group of men as members of the cement industry—you who can boast a most enviable record along these lines.

"But there is perhaps a new thought that I can bring to you today and that is, the freedom of power. I desire to bring to your mind for serious thought safety as a force. Were we to look into the dictionary for the meaning of safety we will find that safety means freedom from danger. Looking again we find that force means power. Therefore, in dealing with the complex picture of life we have at once the subject of our thought for this afternoon, freedom of power. What a vast and tremendous influence for good or bad, is such an instrument in our hands!

"Power is behind every human activity, but only through the channel of safety can it function successfully. Power without restraint is dangerous, but when that power has in its makeup the safety valve of universal safety, it at once becomes potent in the hands of the worker. Power linked with freedom from danger is power such as the world has never known before.

Col. E. C. Spring

"I predict that in the very near future business of all classes will come to the stern reality that safety offers the one and only solution to practically all economic and social problems. Many may thing that some of us are wild and unbalanced in such a theory; to them I point to the results already accomplished in certain big business such as that which you represent. Has safety not proven that it is the common ground upon which any industrial problem can be thrashed out without fear or favor? I think you will all admit that it has.

"The strides made by safety since the world began to recognize its merit, has passed through the kindergarden period and the adolescent stage until within 15 years of its organized inception it has grown to manhood and stands today in all its majesty and might, a new power, a new religion, a science destined to revolutionize the civilized world, a safety valve that gives us freedom of power without danger.

"The safety appeal is, first of all, a human appeal. It addresses itself to the best there is in our makeup, and at once half the problem has been solved."

First-Aid Featured

The first-aid competition under the direction of R. D. Currie, safety engineer of the United States Bureau of Mines, was a very interesting feature of the program. All of the teams were neatly uniformed and displayed a high state of efficiency in resucitation and other first-aid operations. Mr. Currie was assisted by James Westfield, first-aid instructor of the bureau. The team of the Glens Falls Portland Cement Co., Glens Falls, N. Y., was judged winner of the competition with the teams of the North American Cement Corp., Howes Cave and Catskill, and that of the Lone Star Cement Co., New York, Hudson, being accorded second honors. E. H. Parry, safety director of the Glens Falls company, who acted as encourager and "backer" of the winning team, immediately wired the news to the Glens Falls plant where it was bulletined

R. B. Fortuin

and led to a general round of safety enthusiasm among the employes that evening.

Round Table Led by A. G. Beck

The round table discussion, led by A. G. Beck, superintendent of plant No. 1 of

the Canada Cement Co., Montreal, proved extremely valuable. The paper read by Mr. Beck in opening this feature contains so many valuable ideas based on his long experience that it is given herewith in full. Mr. Beck said:

"The position which our industry occupies in the vast safety movement should be a matter or pride and gratification to all who have any connection with it.

"In a comparatively short time, through the vision and wisdom of the outstanding executives of the various companies, through the capable guidance and leadership of the Bureau of Accident Prevention and Insurance of the Portland Cement Association, and through the earnest and sincere efforts of such safety enthusiasts as are gathered here today, it has been demonstrated, beyond any doubt, that accidents can be reduced to the vanishing point.

"The success which is achieved by the individual plant, in this work, is dependent, very largely, upon the whole-hearted and enthusiastic co-operation of the whole plant personnel. It is quite probable that we shall always have some accidents, but it is certain that we are rapidly approaching the time when, to have very many, will cast a shadow of reproach upon plant manager, superintendent, safety director and foremen.

Quarry and Crushing Plants

"A few minutes of your time will be occupied with a discussion of quarry and crushing accidents. We interpret quarry accidents as all accidents incidental to rock quarrying, shale quarrying and clay pit operation. Crushing is similarly construed to mean the crushing of these various materials. This subject is too comprehensive to permit, in the limited time at our disposal, any more than the most casual reference to the more prominent and frequent causes of accidents in these departments and a few suggestions for improvement.

"Our quarries, bearing in mind the above definition, account for slightly more than 20% of the total labor used in our industry. Crushing consumes about 5% of our labor. What proportion of our accidents originate in these two departments? We can answer this question best, I believe, if we take a composite quarrying and crushing operation. By this we mean the average of the experience of all plants reporting their accidents to the Portland Cement Association.

"Statistics for the year 1928 are not yet available. In order to get a proper perspective, we will go back to the year 1926 and we find that the quarry then accounted for 20.9% and crushing for 5.6% of the total accidents reported. Both these departments for this year had at least ½ of 1% more accidents than their proportion of labor entitled them to.

"For the year 1927, the quarry supplied 20.2% and crushing 4.4% of the total accidents reported. Crushing for this year showed splendid progress in reducing accidents, while the quarry was able to show only slight improvement.

"A large number of quarry accidents are caused by hazards which are by no means peculiar to a quarry, but which exist in all departments of our plants. For instance, falls due to tripping and slipping and stepping on rolling objects, which caused in 1927, 22.5% of the accidents in this department; articles in hands of injured 10.7; strain from lifting 6.8%. Then we have other common accident producers like pulleys and sheaves, set screws, keys and machinery.

"There are other hazards, however, which are encountered nowhere around our plants excepting in the quarry. Falling and sliding on rock and clay in the quarry, during 1927, accounted for 56 accidents; some of which, very likely, were serious with high disability charges. Here we have a hazard which cannot be taken care of by guarding—that is by the erection of any kind of barrier or mechanical guard. It does seem, however, that we should strive to cut down the toll which it now exacts. If we are going to attack this accident producer effectively and successfully, it would appear that we must start to curb this evil in the first operation of quarrying—drilling.

R. D. Currie

"The drill holes must be properly spaced. By proper spacing, we mean that no individual hole must carry a greater burden than the quantity of explosives which we can load into the hole can satisfactorily fragmentate.

Scientific Blasting

"If holes are spaced in this manner, drilled to the correct depth and the proper quantity of explosives placed in them (this quantity should be determined by carefully computing the tons of rock to be blasted and the performance factor of the dynamite should also be kept in mind), then, if the dynamite is properly tamped and stemmed, and if any open seams which exist are filled with stemming so that the gases generated by the detonation of the explosive cannot escape, but will be confined, we will have a blast in which the rock is properly broken—one which will require a minimum of secondary blasting and consequently there will be little need or cause for our men to climb over or work around it; and our accidents from this cause will be reduced.

"As a compensation for the additional effort so expended we are quite sure to discover reduced explosive costs and a worthwhile reduction in shovel and crusher delay through reduced secondary blasting.

"Another hazard peculiar to the quarry is caused by the storage and handling of explosives and their use in blasting. Nearly all accidents in connection with the use of explosives have to do with premature explosions, or else with misfires or imperfect detonations. This kind of accident, while not very numerous, nearly always causes serious injury, and frequently involves men not directly engaged in the loading or blasting operation.

"Our industry is a consumer of large quantities of explosives. I imagine that every ton of rock used in our process has had somewhere between one-third to one-fifth pounds of explosives expended on its blasting. Explosives do not explode or detonate of their own accord, and we might possibly say that every explosive accident occurs because the human element having to do with it did something which it should not have done. Capable, reliable, experienced and conscientious men and thoroughly safe methods are the only means of keeping us out of trouble. Those of us who possess a crew of explosives men conforming to these specifications are fortunate indeed.

"No one, unless he is by temperament cautious and disinclined to experiment, is suitable for a powderman. Safe powdermen are in most instances such because some one through infinite care taught them the proper technique. The United States Bureau of Mines issues a number of bulletins and all the large explosive companies gladly supply any customer with worthwhile information.

"Cordeau-Bickford, where conditions are such that it can be used without too serious an increase in blasting costs, has quite a few advantages from a safety viewpoint over electric caps or any other means of detonating explosives, and especially so if the powder column is to be split.

"Flying material—pieces of rock from secondary blasting—cause quite a few accidents. Supplying shelters, conveniently located, and enforcing their use takes care of those in the immediate vicinity of blasting operations. If the quarry happens to be in such close proximity to the mill buildings that those working in other departments are in the danger zone whenever they step outside of the buildings, some warning signal like a siren can be used to warn them.

Transportation Hazards

"Rolling stock—quarry cars and locomotives—holds quite a prominent place as an accident producer. Men are hit while uncoupling cars preparatory to their being pulled into the crushing department; or they fail to notice approaching cars or are injured between cars or in some similar way. Alert workers, each performing his job with proper regard for the safety of fellow workers, is all I can suggest for this hazard.

"Where wire rope and hoists are used for pulling loaded cars up an incline from the quarry to the crusher, careful and regular inspection of the ropes used becomes imperative in order to guard against rope breakage, runaway cars, etc., with serious damage to the human element, rolling stock and quarry equipment.

Crushing Plant

"Let us now give crushing hazards a few minutes consideration. For the year 1927 this department had 61 accidents. The causes producing the greatest number of accidents were as follows:

"(1) Falling, sliding or rolling objects	13
"(2) Articles in hands of injured	10
"(3) Strains from lifting	6
"(4) Falls due to tripping and slipping	5
"(5) Rolling stock	3
"(6) Sharp edges or points	3
"(7) Pulleys and sheaves	3
"(8) Sliding rock in bins	3

"The thing that most impresses me, is the amazingly small number of accidents in this department caused by machinery. There was only one such accident. The three caused by pulleys and sheaves might possibly be brought under the machinery classification, but even then this department in 1927 made a wonderful showing.

"Sliding rock in bins, if men enter to work inside, is a real menace to safety and has accounted for a good many accidents including some very serious ones.

"Falls from tripping and slipping during 1927, in all departments of our plants, occasioned almost twice the number of accidents which were caused by machinery. Why such a large accident total should occur from so simple a cause, I am unable to understand.

"A good many crushing plants have a very real accident hazard in connection with the primary rock crusher. If the crusher has a large open receiving hopper, into which the rock is dumped, and if the cars are delivered to the crusher by means of rope haulage, there is the ever-present danger of crusher attendants being struck by the ropes and tumbled or thrown into the crusher.

"Frequently, the crusher layout is such that no mechanical guard can be erected, and the crusher man and car dumpers are dependent for their safety upon rigid adherence to safe practice and to alertness and attention.

"We have a hazard of this type, and seem able to control it, but only to experience accidents at other points where the potential hazard is not 1/100 as great. Why accidents can be prevented at one location, which is fraught with danger, but will occur at some other point, which may be almost ideal from a safety viewpoint, has always been one of the enigmas of accident prevention to me."

Dinner Program

D. P. Cooper, vice-president of the Lone Star Cement Co., New York, who acted as toastmaster at the dinner, assured those present that the cement industry was unanimous in its decision to banish industrial accidents and that the executives could be depended upon to do their share. Dr. R. M. Little, in charge of the rehabilitation bureau of the state department of education analyzed recent records in the cement industry and gave extremely valuable pointers as to the information necessary to hold present records, and in pressing on to even better ones. An excellent musical entertainment, arranged by the local committee, was enjoyed by all. The complete registration for the meeting follows:

Registration

Alpha Portland Cement Co., Easton, Penn.

Edw. F. Bogue, bookkeeper.
Mike Cremic, blacksmith.
W. H. Garis, chemist.
R. Geneis, engineer.

D. P. Cooper

William Gorman, chemist.
Wallace Kolar, quarry foreman.
John Musin, foreman.
William H. Overbaugh, electrician.
Thos. F. Quinlan, electrician.
Edw. Leonard Sumitt, packing-house foreman.
Clarence Spars, mill foreman.
Daniel L. Ziegler, plant engineer.

Atlas Portland Cement Co., New York, N. Y.

H. R. Andrews, chief electrician.
Martin Gannon.
Lewis Sickle.
Chester M. Storms.

Canada Cement Co., Ltd., Montreal, Que., Can.

A. G. Beck, superintendent, plant No. 1.
Edward Gariepel, associate editor.
W. H. Grady, safety director.
F. M. Whelan, superintendent's clerk.

Glens Falls Portland Cement Co., Glens Falls, N. Y.

Thos. Arthur, head oiler.
Vito Bellefinini, driller.
Clifford H. Boyden, repair man.
James Cunningham, machinist.
James J. Donovan, Jr., locomotive engineer.
Jos. A. Donovan, assistant safety director.
Clarence Hesliky.
John J. Hesliky, shipping foreman.
F. C. Lemery, electrician foreman.
Fred Lupien, foreman.
Thomas Maher, general night foreman.
John F. Mooney, chief burner.
Andrew Nelson, carpenter foreman.
P. H. O'Leary, acetylene welder.
E. H. Parry, safety director.
Alexander Prevost, foreman.
Fred Prevost, repair man.
Herbert W. West.

Lone Star Cement Co. New York, Albany, N. Y.

C. S. Andres, superintendent.
Edward F. Baker, electrician.
Joseph J. Brady, chemist.
William Braker, kiln burner.
James Cole, repair man.
Dominick Conte, blaster.
D. P. Cooper, vice-president.
Arthur M. Couine, stenographer.
Jos. Donohue, repair man.
Fred W. Ewel, engineer.
W. O. Griffith, foreman.
Ernest Hansen, machinist.
L. R. Hennessy, chemist.
Charles Howard, packing-house foreman.
J. B. Howie, assistant chief engineer.
Earl Johns, mill foreman.
George A. Johnson, carpenter.
John O. Johnson.
Guy H. Miller, engineer.
R. R. Perine, auditor.
Harry Putnam, electrician.
Charles M. Reynolds, foreman.
H. A. Ross, treasurer.
Thomas Russell, locomotive engineer.
John Schmusky, foreman of construction.
Frank J. Smith, Night mill foreman.
Raymond Smith, packing department.
W. E. Trowbridge, bag-house foreman.
Vincent Wallace, machinist.
A. G. Willheim, general foreman.
Job Zelman, kiln burner.

North American Cement Corp., Albany, N. Y.

George Aloncle, chauffeur.
William P. Coffin, engineer.
S. D. Currier, electrical engineer.
William Farrell, clerk in stock room.
George A. Flicker.
Daniel Griscom, machinist.
Ralph V. Grobe, electrician.
C. A. Hartman, quarry foreman.
E. S. Hill, assistant superintendent.
F. W. Kelley, president.
Lorenzo Livingston, analyst.
W. F. O'Brien, assistant superintendent.
E. H. Parks, cashier.
C. R. Parks, treasurer.
A. G. Partain, electrician.
Charles Pavlock.
J. O. Reed, foreman.
S. H. Rhodes, chief electrician.
William J. Shufelt, foreman, power department.
Donald Shutt, foreman, bag department.
Paul Van Dyke, power department.
Herbert S. Vaughn.
G. A. Witte, assistant general manager.
H. G. Wright, chief engineer.

Pennsylvania-Dixie Cement Corp., Nazareth, Penn.

Fred Bahls, boiler man.
Brooks Bonstein, chief engineer.
Frank D. Bower, safety engineer.
C. L. Brobst, millwright.
David Fortuin, chief clerk.
R. B. Fortuin, assistant to general manager.
Burton H. Greene, power-house operator.
George H. Hildreth, dragline operator.
Raymond Hoaglin, foreman.
Edward C. Howell, quarry crusher.
Ward Teeter, pack house.
F. P. Werner, superintendent.

Miscellaneous

Geo. Campbell, general manager, General Electrical Co., Schenectady, N. Y.
R. D. Currie, associate mining engineer, U. S. Bureau of Mines, Pittsburgh, Penn.
A. J. R. Curtis, Portland Cement Association, Cnicago, Ill.
John A. Forrest, district manager, State Insurance Fund, Albany, N. Y.
H. W. Gabor, safety engineer, New York State Insurance Fund, New York City.
John D. Harndere, assistant manager, General Electric Co., Schenectady, N. Y.
John N. McDonell, safety inspector, State of New York, Albany, N. Y.
Frank J. Poulioh, safety inspector, State Fund, Albany, N. Y.
Joseph E. Smith, solicitor, State Insurance Fund, Albany, N. Y.
A. K. Vradenburgh, safety inspector, State Insurance Fund, Albany, N. Y.
John B. Wellworth, solicitor, State Insurance Fund, Albany, N. Y.
James Westfield, first-aid mines, U. S. Bureau of Mines, Pittsburgh, Penn.

Start Work on Magnesite Plant

Work has been started upon the $200,000 magnesite-preparing plant of the F. E. Schundler company at Joliet, Ill., to replace the unit destroyed two months ago in a $300,000 fire. The new plant, when completed, will represent an investment of nearly $500,000 with machinery and equipment.

Lone Star Loses Portland Cement Association Trophy Through Eye Accident

ANNOUNCEMENT has been reluctantly made by the Committee on Accident Prevention of the Portland Cement Association that, contrary to earlier announcements, award of the Association Safety Trophy for 1928 has been lost by the Lone Star Cement Co., Virginia.

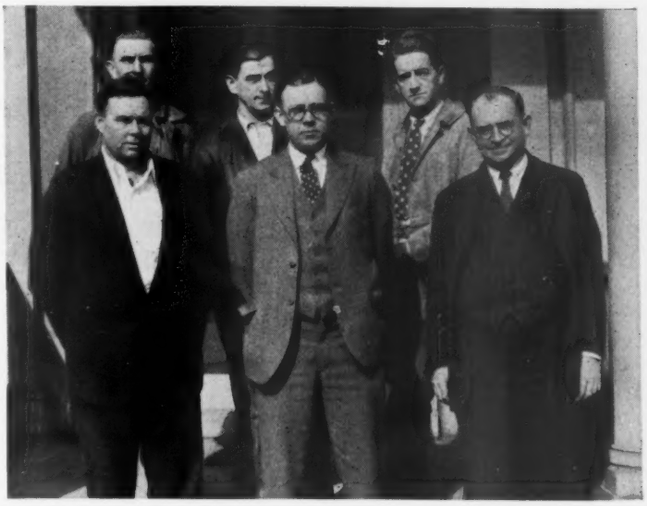
On January 1, 1929, the 1928 record of the Lone Star plant at Norfolk, Va., was found to be entirely clear and subsequent canvass revealed to the Accident Prevention Committee that this mill organization had had no lost-time, permanent disability or fatal accidents and had carefully complied with all of the regulations of the contest. Consequently it was announced as a winner and orders placed for one of the handsome cast-stone trophies to adorn the grounds at the Norfolk plant.

Subsequently it was discovered that a slight injury caused by a spatter of slurry on the eye of E. Lawrence, raw-mill operator, had resulted in a rupture of the iris, causing a slight cast or cataract, the removal of which would probably leave a scar with a certain impairment of vision. Still, competent eye surgeons have stated that in such cases, where the sufferer is as young as Mr. Lawrence (25 years), the impairment may entirely clear after a number of months. However, a settlement of the claim was made by the liability insurance carrier which was approved by the Industrial Commission of Virginia by which, obviously, permanent disability was admitted.

Although Mr. Lawrence lost no time and there were no other lost-time accidents in this mill in 1928, the apparent permanent disability bars the Norfolk plant from receiving the Association trophy for 1928 and the management gracefully withdrew from the contest.

E. Posselt, vice-president of the International Cement Corp., parent company of the Lone Star Cement Co., Virginia, in discussing the matter, said recently:

"Our Virginia organization is naturally sorry to lose the association trophy, with all of the prestige and honor it carries with it. However, we have always felt that we want to win only by an absolutely perfect record, and when we succeed, as we hope to in 1929, our men will prize their achievement, as well as the trophy, all the more highly."



Safety committee at the Virginia plant. First row, L. White, H. Williams, A. Crowe. Second row, O. Eurling, A. Enax, E. Woodward

In 1927 the Norfolk plant came very near to winning the coveted trophy, a disqualifying accident having occurred on December 31.

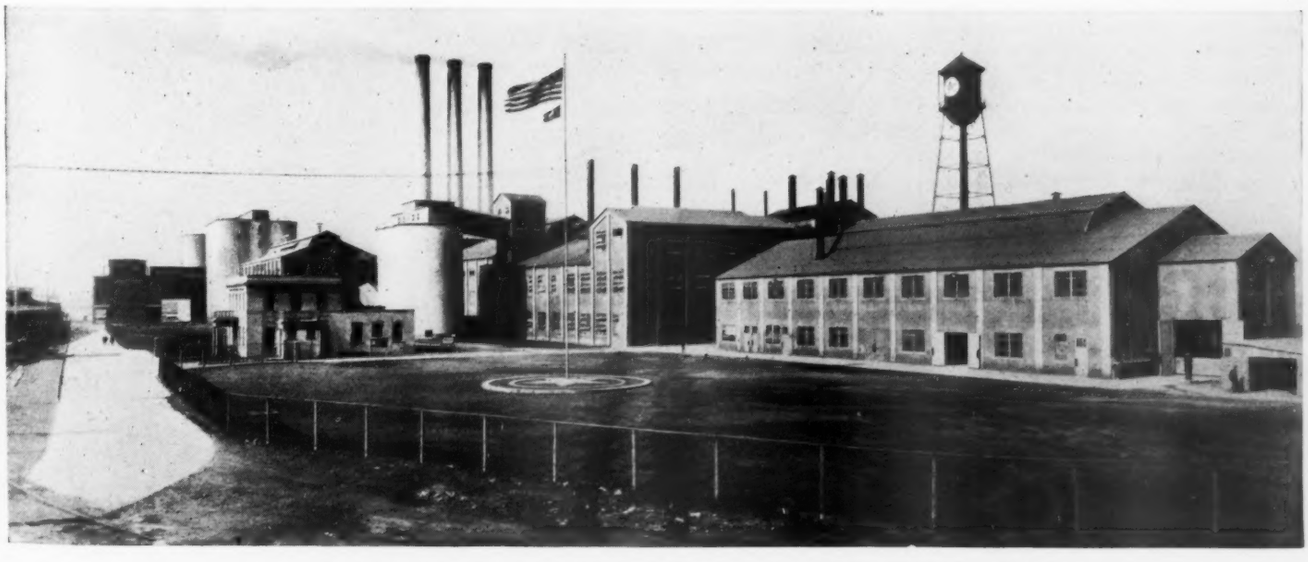
President Struckmann Leads New Effort

On Thursday April 4, the foreman and safety committeemen of the mill met in special session, H. Struckmann, president, Dwight Morgan, vice-president, C. F. Martinez, superintendent and A. J. R. Curtis, assistant to general manager of the Portland Cement Association, for the purpose of formulating further plans to clinch the 1929 trophy. After a thorough inspection of the mill, Mr. Struckmann complimented the organization and gave ample demonstration of his appreciation of the good safety record already attained as well as his interest in capturing the 1929 prize.

Dwight Morgan, vice-president of the Lone Star company, Virginia, recently made public the pledge of his company to support the forthcoming June No-Accident Campaign of the Association which reads in part as follows:

"The Lone Star Cement Co., Virginia, enrolled eagerly in the campaign to operate the cement industry during June, 1929, without a lost-time accident. This year our men feel better prepared than ever to make our record an outstanding example of industrial efficiency.

"We are appealing to every man in our organization to aid in this campaign and failure is therefore unthinkable."



The plant of the Lone Star Cement Co., Virginia, with the safety flag flying

Portland Cement Production for March

Production Is 2.5% Less Than March, 1928, and Shipments 0.2% Less

THE PORTLAND CEMENT INDUSTRY in March, 1929, produced 9,969,000 bbl., shipped 10,113,000 bbl. from the mills and had in stock at the end of the month 29,727,000 bbl., according to the United States Bureau of Mines, Department of Commerce. The production of portland cement in March, 1929, showed a decrease of 2.5% and shipments a decrease of 0.2%, as compared with March, 1928. Portland cement stocks at the mills were 8.3% higher than a year ago.

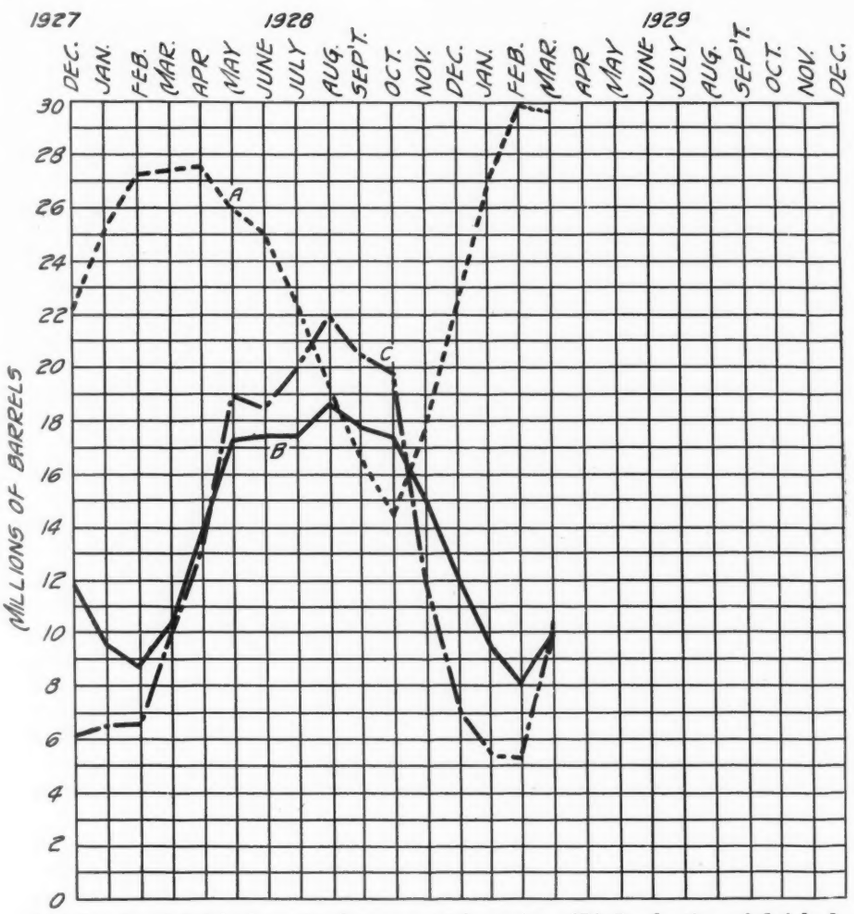
The statistics here presented are compiled from reports for March from all manufacturing plants except two, for which estimates have been included in lieu of actual returns. Comparisons are made with the February statistics, for which just the same number of plants reported.

Statistics for 160 Plants

In the following statement of relation of production to capacity the total output of finished cement is compared with the estimated capacity of 160 plants at the close of March, 1929, and of 155 plants at the close of March, 1928. In addition to the capacity of the new plants which began operating during the 12 months ended March 31, 1929, the estimates include increased capacity due to extensions and improvements at old plants during the period.

RELATION OF PRODUCTION TO CAPACITY

	Mar. 1929 Pct.	Mar. 1928 Pct.	Feb. 1929 Pct.	Jan. 1929 Pct.	Dec. 1928 Pct.
The month	47.4	51.7	44.8	46.5	60.4
12 months ended	70.9	74.6	71.0	71.0	74.0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(MILLIONS OF BARRELS
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A
B
C

(A) Stocks of finished portland cement at factories; (B) Production of finished portland cement; (C) Shipments of finished portland cement from factories

PRODUCTION AND STOCKS OF CLINKER, BY MONTHS, IN 1928 AND 1929

Month	1928—Production—1929		Stocks at end of month 1928	1929	Month	1928—Production—1929		Stocks at end of month 1928	1929
January	11,839,000	12,041,000	9,672,000	9,642,000	July	15,981,000	.....	11,707,000	.....
February	11,363,000	11,255,000	12,237,000	*12,436,000	August	16,202,000	.....	9,357,000	.....
March	12,501,000	12,446,000	14,463,000	14,951,000	September	15,909,000	.....	7,566,000	.....
April	13,844,000	.....	15,002,000	.....	October	15,782,000	.....	5,944,000	.....
May	16,025,000	.....	14,329,000	.....	November	14,930,000	.....	5,953,000	.....
June	15,940,000	.....	12,944,000	.....	December	13,426,000	.....	7,422,000	.....

*Revised.

PORTLAND CEMENT SHIPPED FROM MILLS INTO STATES, IN JANUARY AND FEBRUARY, 1928 AND 1929, IN BARRELS*

Shipped to	1928—January	1929	1928—February	1929
Alabama	235,233	125,356	254,968	105,162
Alaska	396	132	928	.....
Arizona	82,184	55,771	72,365	58,844
Arkansas	62,143	†47,087	76,288	40,599
California	1,030,965	950,884	909,617	901,071
Colorado	32,389	27,709	33,593	25,474
Connecticut	74,600	57,087	52,401	54,574
Delaware	13,077	10,183	11,304	14,459
District of Columbia	30,341	60,476	55,069	58,207
Florida	108,750	93,827	105,590	92,217
Georgia	113,857	92,494	97,616	73,064
Hawaii	20,290	21,829	26,923	20,683
Idaho	6,408	3,266	11,020	3,792
Illinois	354,763	211,984	401,092	251,883
Indiana	88,411	65,421	102,747	87,506
Iowa	30,488	17,701	41,520	21,406
Kansas	78,460	43,008	107,291	56,678
Kentucky	54,991	33,118	52,748	32,328
Louisiana	94,929	96,054	97,484	81,109
Maine	12,487	10,011	10,738	15,199
Maryland	87,650	60,058	66,413	59,087
Massachusetts	104,382	85,539	100,548	79,633
Michigan	267,206	247,190	287,114	273,538
Minnesota	50,480	30,494	49,334	44,013
Mississippi	57,528	83,044	50,677	50,254
Missouri	146,411	†91,914	170,275	109,614
Montana	8,289	3,525	10,578	5,570
Nebraska	26,815	16,113	33,967	15,409
Nevada	3,293	6,703	4,524	6,785
New Hampshire	17,647	17,988	18,066	17,091
New Jersey	318,204	238,270	296,641	247,004
New Mexico	12,861	30,915	21,302	16,549
New York	800,428	746,897	768,681	667,767
North Carolina	135,292	108,492	100,830	85,373
North Dakota	2,102	2,020	2,641	2,502
Ohio	265,048	250,972	298,885	253,420
Oklahoma	201,422	†153,893	203,245	112,301
Oregon	37,133	33,364	74,793	34,733
Pennsylvania	441,419	378,421	404,956	373,929
Porto Rico	.....	500	.....	3,745
Rhode Island	25,325	16,956	18,701	25,497
South Carolina	102,178	96,379	75,677	74,035
South Dakota	5,988	4,414	10,434	4,361
Tennessee	88,966	96,513	109,112	80,026
Texas	405,245	†482,644	383,884	424,778
Utah	9,575	13,185	15,131	11,850
Vermont	11,363	8,794	15,902	14,066
Virginia	91,941	86,620	104,674	83,678
Washington	90,604	111,351	128,568	68,792
West Virginia	39,992	33,367	44,944	35,675
Wisconsin	74,881	57,769	91,829	74,696
Wyoming	5,262	4,216	8,427	3,818
Unspecified	32,918	12,410	22,737	47,710
	6,493,010	5,634,328	6,514,792	5,401,554
Foreign countries	47,990	72,672	48,208	46,446
Total shipped from cement plants	6,541,000	5,707,000	6,563,000	5,448,000

*Includes estimated distribution of shipments from three plants in January and February, 1928, and in January, 1929; from four plants in February, 1929.
†Revised.

PRODUCTION, SHIPMENTS, AND STOCKS OF FINISHED PORTLAND CEMENT, BY DISTRICTS, IN MARCH, 1928 AND 1929, AND STOCKS IN FEBRUARY, 1929

District	Production 1928—March—1929		Shipments 1928—March—1929		Stocks at end of month 1928—March—1929		Stocks at end of Feb. 1929*
Eastern Penn., N.J. and Md.	2,512,000	2,513,000	2,396,000	2,506,000	6,682,000	6,941,000	6,933,000
New York and Maine	587,000	593,000	499,000	504,000	1,866,000	2,073,000	1,984,000
Ohio, W'n Penn., and W.Va.	851,000	908,000	834,000	869,000	3,411,000	3,650,000	3,611,000
Michigan	560,000	476,000	505,000	543,000	2,260,000	2,591,000	2,658,000
Wis., Ill., Ind. and Ky.	933,000	1,086,000	1,004,000	948,000	3,661,000	4,049,000	3,911,000
Va., Tenn., Ala., Ga., Fla., La.	1,268,000	1,028,000	1,298,000	960,000	1,935,000	2,248,000	2,180,000
E'n Mo., Iowa, Minn., S. D.	687,000	644,000	730,000	700,000	3,912,000	4,297,000	4,353,000
W'n Mo., Neb., Kans., Okla.	645,000	620,000	829,000	905,000	1,463,000	1,497,000	1,782,000
Texas	552,000	527,000	562,000	594,000	450,000	446,000	513,000
Colo., Mont. and Utah	160,000	57,000	174,000	144,000	482,000	454,000	541,000
California	1,171,000	1,170,000	1,082,000	1,148,000	860,000	894,000	871,000
Oregon and Washington	297,000	347,000	222,000	292,000	463,000	587,000	533,000
	10,223,000	9,969,000	10,135,000	10,113,000	27,445,000	29,727,000	29,870,000

PRODUCTION, SHIPMENTS AND STOCKS OF FINISHED PORTLAND CEMENT, BY MONTHS, IN 1928 AND 1929

Month	1928—Production—1929		1928—Shipments—1929		Stocks at end of month 1928	1929
January	9,768,000	9,881,000	6,541,000	5,707,000	25,116,000	26,797,000
February	8,797,000	8,522,000	6,563,000	5,448,000	27,349,000	*29,870,000
March	10,223,000	9,969,000	10,135,000	10,113,000	27,445,000	29,727,000
April	13,468,000	.....	13,307,000	.....	27,627,000	.....
May	17,308,000	.....	18,986,000	.....	25,984,000	.....
June	17,497,000	.....	18,421,000	.....	25,029,000	.....
July	17,474,000	.....	19,901,000	.....	22,580,000	.....
August	18,759,000	.....	21,970,000	.....	19,374,000	.....
September	17,884,000	.....	20,460,000	.....	16,799,000	.....
October	17,533,000	.....	19,836,000	.....	14,579,000	.....
November	15,068,000	.....	11,951,000	.....	17,769,000	.....
December	12,189,000	.....	7,384,000	.....	22,650,000	.....
	175,968,000	.....	175,455,000	.....	.....	.....

*Revised.

PRODUCTION AND STOCKS OF CLINKER (UNGROUND CEMENT), BY DISTRICTS IN MARCH, 1928 AND 1929

District	1928—Production—1929		Stocks at end of month 1928	1929
Eastern Pennsylvania, New Jersey and Maryland	2,939,000	2,958,000	1,948,000	2,526,000
New York and Maine	750,000	778,000	1,023,000	1,347,000
Ohio, Western Pennsylvania and West Virginia	1,124,000	1,209,000	1,890,000	1,777,000
Michigan	908,000	740,000	1,880,000	1,354,000
Wisconsin, Illinois, Indiana and Kentucky	1,662,000	1,793,000	2,457,000	2,477,000
Virginia, Tenn., Alabama, Georgia, Florida, Louisiana	1,226,000	1,146,000	995,000	1,418,000
Eastern Missouri, Iowa, Minnesota, South Dakota	913,000	926,000	1,096,000	1,102,000
Western Missouri, Nebraska, Kansas and Oklahoma	666,000	724,000	559,000	798,000
Texas	544,000	554,000	149,000	216,000
Colorado, Montana and Utah	212,000	188,000	442,000	537,000
California	1,180,000	1,079,000	1,410,000	971,000
Oregon and Washington	377,000	351,000	614,000	428,000
	12,501,000	12,446,000	14,463,000	14,951,000

Exports and Imports

Compiled from the records of the Bureau of Foreign and Domestic Commerce and subject to revision.

EXPORTS OF HYDRAULIC CEMENT BY COUNTRIES IN FEBRUARY, 1929

Exported to	Barrels	Value
Canada	3,010	$ 13,850
Central America	4,717	13,717
Cuba	5,256	16,034
Other West Indies	4,888	15,222
Mexico	8,059	27,391
South America	25,562	103,699
Other countries	7,394	35,677
	58,886	$225,590

IMPORTS OF HYDRAULIC CEMENT BY COUNTRIES AND BY DISTRICTS, IN FEBRUARY, 1929

Imported from	District into which imported	Barrels	Value
Belgium	Florida	3,750	$ 3,378
	Galveston	400	2,769
	Los Angeles	43,430	23,659
	Massachusetts	7,102	8,856
	Porto Rico	2,000	3,800
	South Carolina	10,000	12,396
	Total	66,682	$ 54,858
Canada	Me. & N. H.	71	$ 187
Denmark	Porto Rico	37,650	$ 49,220
Norway	Porto Rico	1,000	$ 1,360
	San Francisco	7,750	8,525
	Total	8,750	$ 9,885
United K'gd'm.	New York	5,777	$ 8,973
	Grand total	118,930	$123,123

DOMESTIC HYDRAULIC CEMENT SHIPPED TO ALASKA, HAWAII AND PORTO RICO, IN FEBRUARY, 1929

	Barrels	Value
Alaska	375	$ 1,144
Hawaii	23,234	52,424
Porto Rico	2,559	7,138
	26,168	$60,706

Chambers of Commerce to Consider Other Factors Than Promoting New Enterprises

THE FACTORS which a community should take into consideration in determining its future industrial expansion program will be discussed at a special round-table conference at the Seventeenth Annual Meeting of the Chamber of Commerce of the United States at Washington, April 29.

This conference, it is announced, will examine contentions that there exists a considerable excess of manufacturing capacity in the country, taking into account the factors of uneconomic plant location and obsolescence of commodities, plant, equipment and management.

In discussing industrial extension problems, the conference will have the benefit of considerable information developed by the National Chamber's Department of Manufacture. This department has made definite progress in urging chambers of commerce and trade associations to work in closer co-operation in connection with proposed industrial expansion programs. Where expansion is desired the department has encouraged local chambers of commerce to make an industrial survey before embarking on any plan looking to the enlargement of their manufacturing areas. Both suggestions have proven beneficial to communities in mapping out their industrial extension programs.

The round-table discussion will be directed toward three main topics. The first relates to the nation's manufacturing capacity. In this connection consideration will be given to such questions as: What factors common to most industries should be considered in an appraisal of the extent of the economic location of manufacturing plants? What proportion of all plants built prior to 1920 may be considered to be (1) uneconomically located to meet present day competition, and (2) obsolete in commodities, plant, equipment or management?

Under the general subject of modernization of plants, the conference will take up two items: Can obsolescent plants be modernized, or are most such plants on their way to the scrap heap? Is it practicable to organize the manufacturers of a locality through their chamber of commerce for the purpose of continuous study of methods for keeping up-to-date on plant operation and management?

The third topic will go into the matter of co-operation between chambers of commerce and trade associations in planning sound industrial extension.

This round-table will draw together manufacturers, chamber of commerce secretaries, industrial bureau managers, public utility men, industrial engineers and others.

EXPORTS AND IMPORTS OF HYDRAULIC CEMENT, BY MONTHS, IN 1928 AND 1929

Month	1928—Exports		1929—Exports		1928—Imports		1929—Imports	
	Barrels	Value	Barrels	Value	Barrels	Value	Barrels	Value
January	56,400	$ 204,875	78,639	$ 283,002	234,753	$ 342,797	151,302	$ 177,976
February	62,828	221,620	58,886	225,590	164,408	217,525	118,930	123,123
March	74,983	265,719	.....	.....	235,930	330,074	.....	.....
April	61,676	205,882	.....	.....	249,458	324,371	.....	.....
May	70,173	236,005	.....	.....	190,509	256,872	.....	.....
June	59,536	201,313	.....	.....	266,537	359,637	.....	.....
July	83,759	291,055	.....	.....	112,887	151,877	.....	.....
August	88,736	302,866	.....	.....	259,988	358,858	.....	.....
September	71,995	252,843	.....	.....	173,439	226,295	.....	.....
October	62,137	246,010	.....	.....	152,210	226,909	.....	.....
November	69,313	260,310	.....	.....	67,240	92,468	.....	.....
December	63,120	250,204	.....	.....	175,992	233,300	.....	.....
	824,656	$2,938,702	.....	.....	2,283,351	$3,120,983	.....	.....

Traffic and Transportation

Car Loadings of Sand and Gravel, Stone and Limestone Flux

THE following are the weekly car loadings of sand and gravel, crushed stone and limestone flux (by railroad districts) as reported by the Car Service Division, American Railway Association, Washington, D. C.:

CAR LOADINGS OF SAND, GRAVEL, STONE AND LIMESTONE FLUX

District	Limestone Flux Week ended Mar. 23	Limestone Flux Week ended Mar. 30	Sand, Stone and Gravel Week ended Mar. 23	Sand, Stone and Gravel Week ended Mar. 30
Eastern	2,551	2,946	3,418	4,138
Allegheny	3,222	3,300	3,855	4,040
Pocahontas	401	369	474	595
Southern	479	522	7,319	9,760
Northwestern	848	1,131	2,630	3,706
Central Western	586	569	7,032	8,005
Southwestern	475	395	5,930	6,641
Total	8,562	9,232	30,658	36,885

COMPARATIVE TOTAL LOADINGS, BY DISTRICTS, 1928 AND 1929

District	Limestone Flux 1928 Period to date Mar. 31	Limestone Flux 1929 Period to date Mar. 30	Sand, Stone and Gravel 1928 Period to date Mar. 31	Sand, Stone and Gravel 1929 Period to date Mar. 30
Eastern	24,566	29,699	28,186	26,599
Allegheny	36,303	36,552	33,042	30,998
Pocahontas	2,985	2,232	6,840	4,548
Southern	6,744	5,625	112,678	86,242
Northwestern	8,776	7,850	24,762	16,234
Central Western	5,188	6,347	72,715	69,883
Southwestern	5,102	5,036	57,294	61,286
Total	89,664	93,341	335,517	295,790

COMPARATIVE TOTAL LOADINGS, 1928 AND 1929

	1928	1929
Limestone flux	89,664	93,341
Sand, stone, gravel	335,517	295,790

Proposed Changes in Rates

THE following are the latest proposed changes in freight rates up to the week beginning April 20:

CENTRAL FREIGHT ASSOCIATION DOCKET

21107. To establish following commodity rates on **sand**, carloads, from Battle Creek, Mich.:

To	Pres. (*)	Prop. (†)
Albion, Mich.	200	120
Augusta, Mich.	170	110
Ceresco, Mich.	170	110
Galesburg, Mich.	180	110
Jackson, Mich.	240	‡145
Kalamazoo, Mich.	200	120
Marshall, Mich.	180	110
Parma, Mich.	230	135

*Sixth class rates in Agent Jones' 224-A, I. C. C. 1851, and M. C. R. R., G. F. D. 9400-E, I. C. C. 5587.
†In cents per net ton.
‡Reverse direction rate.

21113. (A) To establish revised rates on **crushed stone** and articles grouped therewith, Marengo and Milltown, Ind., to the following stations, in lieu of the rates now published in Southern Railway General Commodity Tariff 1225G, I. C. C. No. C2126, viz.:

To	Pres.	Prop.
Butlerville, Ind.	122	105
Nebraska, Ind.	127	110
Holton, Ind.	127	110
New Harmony, Ind.	124	115
Stewartsville, Ind.	124	115
Mt. Vernon, Ind.	120	115
Erwin, Ind.	120	115
Solitude, Ind.	119	115
Springfield, Ind.	119	110
Oliver, Ind.	119	110
Hepburn, Ind.	119	110
Wadesville, Ind.	115	110
Wilson, Ind.	115	110

(B) To revise the description in connection with rates on crushed stone, etc., as published in Southern Railway Tariff 1225G, I. C. C. No. C2126, as follows:

Present description: "Stone crushed; stone screenings; and agricultural limestone (not ground or pulverized); in bulk, carloads, minimum weight as provided in Item 135."

Proposed description: "Crushed stone; crushed stone screenings and tailings; agricultural limestone (unburned, in bulk, in open top cars only), also ground stone, carloads."

21124. To establish on **sand and gravel**, carloads, Leesburg, Ind., to Chicago, Ill., via Winona R. R., Milford Jct., Ind., B. & O. R. R., rate of 75c per net ton. Present rate, sixth class.

21147. To establish on **stone, rip rap, rubble** and **rough building stone**, carloads, Neshannock Falls, Penn., to Bay City, Mich., rate of 18c. Present rate, 25c.

Note 1—Minimum weight marked capacity of car.

Note 2—Minimum weight 90% of marked capacity of car.

Note 3—Minimum weight 90% of marked capacity of car, except that when car is loaded to visible capacity the actual weight will apply.

21151. To establish on **sand and gravel**, carloads, Circleville, O., to points shown below, following rates (present and proposed rates in cents per net ton):

To	Prop.	Pres.
Amanda, O.	60	*70
New Holland, O.	60	‡70
Lancaster, O.	65	*70
Washington C. H., O.	70	‡90
North Berne, O.	70	†210
Bremen, O.	75	†210
Melvin, O.	80	‡100
New Lexington, O.	80	†210
Wilmington, O.	85	‡100
Roseville, O.	85	†210
Clarksville, O.	90	‡110
Lanesville, O.	90	‡210
Morrow, O.	95	‡110

*Intermediate from Washington Court House, O.
†Intermediate from North Berne, O.
‡Intermediate from Cincinnati, O.

21158. To establish on **rubble, rip rap and quarry scrap stone**, carloads, from Lisbon, O., to Ohlton, O., rate of 60c per net ton. Present rate, sixth class rate of 210c per net ton.

21176. To establish on **crushed stone**, carloads, East Liberty, O., to Huntsville, O., rate of 70c per net ton. Present rate, 75c per net ton.

21182. To establish on **sand and gravel**, carloads, Troy, O., to points in Ohio, rates as shown in Exhibit "B" attached. Present rates as shown in Exhibit "B" attached (in cents per net ton):

EXHIBIT "B"
FROM TROY, O.

To	Pres.	Prop.
C. C. C. & St. L. Ry. Stations		
Springfield Division		
Springfield, O.	†	65
Durbin, O.	†	65
Donnellville, O.	†	65
New Carlisle, O.	†	60
Brown, O.	†	60
Atlasco, O.	†	60
Grayson, O.	†	60
Miami Siding, O.	†	60
Kessler, O.	*70	60
Ludlow Falls, O.	*70	60
Laura, O.	*70	60
Pittsburgh, O.	*70	65
Arcanum, O.	*70	65
Savona, O.	*70	70
Hewitt, O.	*90	70
Clark, O.	*90	75
Glen Karn, O.	*90	75
Cincinnati Division (Main Line)		
Lagonda, O.	†	70
Moorefield, O.	†	75
Catawba, O.	†	80
Mechanicsburg Gravel Pit, O.	†	80
Mechanicsburg, O.	†	80
Irwin, O.	†	85
Milford Centre, O.	†	85
West Marysville, O.	†	90
Marysville, O.	†	90
New Dover, O.	†	90
Ostrander, O.	†	90
White Sulphur, O.	†	90
Scioto, O.	†	90
Delaware, O.	†	90
C. & S. Branch		
Brooks, O.	†	75
Plattsburg, O.	†	80
Kay Switch, O.	†	80
West London, O.	†	80
London, O.	†	80
Lilly Chapel, O.	†	80
Georgesville, O.	†	80
Galloways, O.	†	80
Avenue, O.	†	80
Miami Crossing, O.	†	80
Columbus, O.	†	80

*Rate from Urbana under intermediate rule.
†Sixth class.

21184. To establish on **crushed stone**, in bulk, carloads, and on **agricultural limestone**, in bulk, in open top cars, carloads, Raney Spur, Ind., to B. & O. R. R. stations, rates as shown in Exhibit "C" attached (in cents per ton of 2000 lb):

EXHIBIT "C"
FROM RANEY SPUR, IND.

To	Prop.	Present A	Present B
Ironton, Ind.	60	60	81
Shoals, Ind.	60	60	81
Martin, Ind.	60	60	81
Loogootee, Ind.	60	60	81
Cannelburg, Ind.	60	60	81
Montgomery, Ind.	60	60	81
Black Oak, Ind.	60	60	81
Washington, Ind.	65	65	81
Shops, Ind.	65	65	92
Hyatts Spur, Ind.	65	65	92
Wheatland, Ind.	70	70	92
Fritchton, Ind.	70	70	92
Vincennes, Ind.	75	75	104
Allison Branch, Ill.	80		104
Jackson Spur, Ill.	80		104
Lawrenceville, Ill.	80		104
Bridgeport, Ill.	85		115
Sumner, Ill.	85		115
Claremont, Ill.	85		127
Olney, Ill.	90		127
Higgins, Ill.	90		127
Noble, Ill.	95		127
Clay City, Ill.	100		138
Flora, Ill.	100		138
Browns Switch, Ill.	100		138
Kenner, Ill.	100		138
Xenia, Ill.	100		138
Greendale, Ill.	100		138
Iuka, Ill.	100		138
Bannister, Ill.	100		138
Salem, Ill.	100		138
Odin, Ill.	110		161
Sandoval, Ill.	110		161
Shattuc, Ill.	115		161
Ferrin, Ill.	115		161
Huey, Ill.	115		161
Carlyle, Ill.	120		161
Beckemeyer, Ill.	120		161
Breeze, Ill.	120		173

A—Applies on agricultural limestone in Indiana.
B—Applies on crushed stone in Indiana and also Illinois.

21187. To establish on **sand and gravel**, carloads, rates in cents per net ton, from Cleves, O.,

To	Pres.	Prop.
Holton, Ind.	85	117
Nebraska, Ind.	85	117
Butlerville, Ind.	90	117
North Vernon, Ind.	90	117

Proposed rates to apply via Lawrenceburg, Ind., and B. & O. R. R.

21225. To establish on **gravel and sand,** except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica, carloads, Terre Haute, Ind., to Donnellson, Ill., rate of 123c per net ton. Route—Via P. R. R., Oakland, Ill., N. Y. C. & St. L. R. R. Present rate, 340c per net ton.

21226. To establish on **sand** (all kinds) and **gravel,** carloads, Huron and Milan, O., to Ironton, O., rate of 160c per ton of 2000 lb. Present rate, 180c per ton of 2000 lb.

21227. To establish on **crushed stone,** in bulk, in open cars, and **stone screenings,** in bulk in open cars, carloads, Maple Grove, O., to Walford, Penn., via Penn. R. R., rate of 155c per net ton. Present rate, 370c per net ton.

21229. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica), and **gravel,** carloads, Follansbee, W. Va., to Ohio destinations shown below, rates on the following basis, for single line hauls (rates in cents per ton of 2000 lb.):

20 miles and under	60
40 miles and over 20 miles	70
60 miles and over 40 miles	80
80 miles and over 60 miles	90
100 miles and over 80 miles	100
125 miles and over 100 miles	110
150 miles and over 125 miles	120
175 miles and over 150 miles	130
200 miles and over 175 miles	**140**

For joint hauls, 20c per ton of 2000 lb. will be added to the above scale.

In computing distances under the above scale, the shortest routes via existing connections for the interchange of carload traffic shall be used, embracing as a maximum the lines of not more than three line haul carriers. Representative rates from Follansbee (rates in cents per ton of 2000 lb.):

To	Miles	Pres.	Prop.
Steubenville, O.	7	60	60
East Liverpool, O.	30	80	70
Bellaire, O.	32	80	70
Cadiz, O.	36	90	70
Dennison, O.	53	105	80
New Comerstown, O.	71	105	90
Coshocton, O.	85	125	100

21238. To amend C. F. A. L. Tariff 224 Series to provide for non-application of class rates on **stone, crushed, rip rap, rubble, rough or broken,** carloads, from Lannon and Waukesha, Wis., to C. F. A. territory therein. To apply in lieu thereof lowest combination of intermediates.

21252. To establish on **sand and gravel,** carloads, Wapakoneta, O., to Bluffton, O., rate of 70c per net ton. Present rate, 90c per net ton.

21253. To establish on **crushed stone,** in bulk, in open cars, carloads, Woodville, O., to Leipsic, O. (N. Y. C. & St. L. R. R. delivery), rate of 90c per net ton. Present rate, 270c per net ton.

21254. To establish on **crushed stone,** carloads, Findlay, O., to Belle, W. Va., rate of 185c per net ton. Present rate, sixth class.

21259. To establish on **sand, lake,** carloads, Gary, Calumet and Willow Creek, Ind., to Port Huron, Mich., rate of 165c per net ton. Present, sixth class. Route—Via Wabash Ry., Detroit, Mich., G. T. or P. M. Rys.

21263. To establish on **crushed stone,** carloads, Lehigh and Thornton, Ill., to Switz City and Bloomfield, Ind., rate of 113c from Lehigh and 126c per net ton from Thornton, Ill. Present rates, classification basis.

21268. To establish on **sand and gravel,** carloads, from Fort Jefferson, O., to Lewisburg, O., rate of 50c per net ton. Present rate, 60c per net ton.

SOUTHERN FREIGHT ASSOCIATION DOCKET

44810. **Crushed stone, etc.,** from Virginia shipping points to N. S. R. R. stations. It is proposed to establish through rates on **crushed stone, slag, rubble stone and broken stone,** in straight or mixed carloads, minimum weight 100,000 lb. (when 90% of marked capacity is less than 100,000 lb., such 90% of marked capacity will apply as minimum), except when cars are loaded to their visible capacity the actual weight will govern, from Alco, Boscobel, Harris Siding, Blue Ridge, Eagle Mountain, Indian Rock, Klotz, Longoor, Longdale, Lynchburg, Miles, Pembroke, Reusens, Ripplemead, Roanoke, Rocky Point and Rostoco, Va., to all stations on the Norfolk Southern R. R. in North Carolina. Rates from and to representative points are as shown below:

From Indian Rock, Va.

To—	Rates in cents per net ton
Mackeys, N. C.	195
Belhaven, N. C.	200
New Bern, N. C.	205
Varina, N. C.	175

From Longdale, Va.

Mackeys, N. C.	205
Belhaven, N. C.	205
New Bern, N. C.	215
Varina, N. C.	185

From Klotz, Va.

Mackeys, N. C.	205
Belhaven, N. C.	215
New Bern, N. C.	225
Varina, N. C.	195

The suggested rates are made on basis of I.C.C. Docket 17517 scale, plus an arbitrary of 25c per net ton.

44824. **Sand,** from Ottawa and Oregon, Ill., to southeastern points. It is proposed to establish for application via Metropolis, Ill., through commodity rates on silica sand, carloads, from Ottawa, Ill., and Oregon, Ill., to Nashville, Tenn., Marietta, Atlanta, Columbus, Augusta, Ga., Birmingham, Anniston, Ala., and other southeastern destinations, said rates to be the same as combinations made on Evansville, Ind., or Cincinnati, Ohio, whichever is lower.

44892. **Crushed stone,** from Boxley, Va., to Hickory Ground, Va. Present rate, 176.2c per net ton (combination). Proposed rate on stone, crushed or rubble, carloads (See Note 3), from Boxley, Va., to Hickory Ground, Va., 165c per net ton.

44961. **Jetty stone,** from Rockton, Parkhill, S. C., Holton and Stockbridge, Ga., to Miami, Fla. It is proposed to establish the following reduced rates on jetty stone, carloads (See Note 3), to Miami, Fla., from Stockbridge, Ga., 312c; from the other origins, 300c per net ton.

44968. **Sand,** from Talbird, N. C., to Leakesville, N. C. Combination rate of 195c per net ton now applies. Proposed rate on **sand,** carloads, minimum weight 100,000 lb. (when 90% of marked capacity is less than 100,000 lb. such 90% of marked capacity will apply as minimum), except when cars are loaded to their visible capacity the actual weight will govern, from Talbird, N. C., to Leakesville, N. C., 165c per net ton. Made on basis of Docket 17517 scale, plus 25c per ton.

44990. **Limestone or marl** to Elkin and Allegheny R. R. stations, from N. & W. Ry. shipping points. It is proposed to publish through rate of 227c per net ton on limestone or marl, ground or pulverized, carloads, minimum weight 60,000 lb., from N. & W. R. R. quarries, viz.: Alco, Austinville, Carmine, Carson, Cloverdale, Coling, Marion, Pontmours and 213 Mile Siding, Va., and 236c per net ton from Saltville, Va., to stations on the Elkin and Allegheny R. R.

SOUTHWESTERN FREIGHT BUREAU DOCKET

17237. **Gravel, stone, etc.,** between points in Oklahoma and points on the Joplin and Pittsburgh Ry. To amend Item No. 6998-C of S.W.L. Tariff No. 44-O, so as to authorize the scale shown therein on **gravel, crushed stone and sand,** carloads (See Note 1), except when loaded to full capacity, actual weight but not less than 50,000 lb. will apply, between points in Oklahoma and points on the Joplin and Pittsburgh Ry., such rates to be based on the actual distance shipment moves, same as for account of lines already shown in the above item. It is contended that since the scale is already applicable from and to Joplin and other Missouri points on the K. C. S. Ry., it is consistent to apply a corresponding basis to and from points on the Joplin and Pittsburgh Ry.

17266. **Phosphate rock,** from points in Tennessee to points in Missouri. To establish a rate of $5.30 per ton of 2000 lb. on phosphate rock, carloads, description and minimum weight as per L. & N. R. R. Tariff G. F. O. 44C, from stations in the Mt. Pleasant-Centreville District, Group 1 in the tariff referred to, to Independence, Jefferson City and Kansas City, Mo. It is pointed out that the present rate to Independence, Jefferson City and Kansas City, Mo., for C. & A. delivery, is $5.21 per ton, whereas rates via other lines reaching these points is $5.30 per ton and that the lower rate via the C. & A. R. R. is due to an error, which it is desired to correct.

17282. **Sand,** from Joplin, Mo., to Birmingham, Ala., and New Orleans, La. To establish a rate of 17c per 100 lb. to Birmingham, Ala., and a rate of 18c per 100 lb. to New Orleans, La., on sand, other than silica, carloads (See Note 1), except when loaded to full visible capacity, when actual weight, but not less than 50,000 lb., will apply, from Joplin, Mo. Shippers state that the present class E basis is prohibitive.

17304. **Agricultural limestone,** from Valmeyer, Ill., to points in Arkansas and Missouri. To establish the following rates in cents per 100 lb. on agricultural limestone (for fertilizer purposes only), carloads (See Note 1), but not less than 80,000 lb., from Valmeyer, Ill., to points on the Mo. Pac. R. R. in Arkansas and Missouri, on and south of the line from Illmo to Poplar Bluff, through Delta and Dexter, Mo.:

Distance	Rates
20 miles and under	3
40 miles and over 20	3½
80 miles and over 40	4
120 miles and over 80	5
160 miles and over 120	6
220 miles and over 160	7

There is a supply of this commodity at Valmeyer, Ill., it is stated, and the rates proposed are as high as can be used in the distribution of this fertilizer. The rates proposed are also in effect at points on the M. & N. A. R. R.

WESTERN TRUNK LINE DOCKET

5338A. Commodity description, change in. **Limestone, agricultural, ground,** carloads, between all points in W. T. L. territory. Present description—"Agricultural limestone or ground limestone." Proposed description—"Ground limestone, crushed or pulverized (not exceeding 200-mesh in fineness), but not air or water floated."

ILLINOIS FREIGHT ASSOCIATION DOCKET

5003. **Sand and gravel,** carloads (See Note 1), from Brookport and Metropolis, Ill., to De Soto, Ill. (via I. C., Marion, Ill., and Mo. Pac.). Present—Class rates. Proposed—$1 per ton of 2000 lb.

TRUNK LINE ASSOCIATION DOCKET

20623. **Limestone, ground or pulverized and limestone dust,** carloads, minimum weight 30,000 lb., from Franklin, N. J., to Marathon, N. Y., Montrose, Kingsley, Penn., $1.90, and Oxford, N. Y., $2.10 per net ton. Reason—The proposed rates are the same as published from Ogdensburg, N. J., to the same points.

20629. **Sand** (blast, engine, foundry, glass, molding or silica), carloads (See Note 2), from Coxsackie, Selkirk, Wemple, Glennmont and South Schenectady, N. Y., to Jersey City (local), N. J., $2.90 per net ton. Reason—The present rate is out of line and it is desired to place same on the proper basis. Proposed rate is comparable with rates on molding sand, carloads, from Crescent, N. Y., and Selkirk, N. Y., to Jersey City and Newark, N. J.

20480, Sup. 1. **Limestone, unburnt, ground or pulverized,** carloads, minimum weight 50.000 lb,, from B. & O. R. R. shipping points shown in Note 72 of Agent Curlett's I. C. C. A239 to all points on the Montour R. R., 10c per 100 lb.

20639. **Crushed stone,** carloads (See Note 2), from Dunbar, Casparis and Connellsville, Bluestone Co., Penn., to points on the B. & O. R. R. in Maryland and West Virginia, west of Cumberland, Md., and within radius of 200 miles. Proposed rates to representative points are as follows from Casparis, Connellsville Bluestone Co. and Dunbar, Penn., to:

Rowlesburg, W. Va.	110
Grafton, W. Va.	110
Buckhannon, W. Va.	130
Bellington, W. Va.	130
Fairmont, W. Va.	90
Jane Lew, W. Va.	120
Sago, W. Va.	130
Weston, W. Va.	130
Flatwoods, W. Va.	140
Cowen, W. Va.	150
Mannington, W. Va.	110
Hope Natural Gas Co.'s Hastings Plant No. 1 and Siding No. 4, W. Va.	120
Lumberport, W. Va.	110
Short Line Junction, W. Va.	110
Morgantown, W. Va.	80
Manheim, W. Va.	110

Reason—The proposed rates are comparable with rates on like commodities for like distances, services and conditions.

20647. **Sand and gravel,** carloads (See Note 2), from Alfred, N. Y., to Andover, N. Y., 50c per net ton. Reason—To meet truck competition.

20651. **Ganister rock,** carloads (See Note 2), from Berkeley Springs, W. Va., to Pittsburgh, Penn., 7½c and to Youngstown, Ohio, 11c per 100 lb. Reason—The proposed rates are the same as rates now published from Reedsville, Mt. Union, Penn., etc., to Pittsburgh, Penn., and Youngstown, Ohio.

20657. **Sand,** other than blast, engine, foundry, molding, glass, silica, quartz or silex, carloads (See Note 2).

	From—	
To—	Morrisville, Penn., Masonville, N. J., to So. Tullytown, Penn.	Pemberton, N. J.
Porter, Del.	1.25	1.25
Kirkwood, Del.	1.25	1.25
Mt. Pleasant, Del.	1.25	1.40
Middletown, Del.	1.25	1.40

Rates in cents per net ton.

Reason—The proposed rates are comparable with rates on like commodities for like distances, services and conditions.

20658. **Building sand,** carloads (See Note 2), from Mapleton District, Penn., to Staten Island Junction to Tottenville, N. Y., inclusive, $3.55 per net ton. Reason—The proposed rates are comparable with rates from the Mapleton District to New York, N. Y.

20659. **Sand,** other than blast, engine, foundry, molding, glass, silica, quartz or silex, carloads, and **gravel,** carloads (See Note 2), from Bacon, Hill, Northeast, Charleston and Principio, Md., to Edgewood, Md., and Magnolia, Md., 75c, and to Middle River, Md., 80c per net ton; also **crushed stone,** carloads (See Note 2), from Rockland, Md., to Middle River, Md., 75c per net ton. Reason—The proposed rates are comparable with rates on like commodities for like conditions.

Sand-Lime Brick Production and Shipments in March

THE following data are compiled from reports received direct from 21 producers of sand-lime brick located in various parts of the United States and Canada. The number of plants reporting is one less than those furnishing statistics for the February estimate published in the March 30 issue. The statistics below may be regarded as representative of the entire industry, the reporting plants having about one-half the production capacity in the United States and Canada.

With the opening up of the spring work, production shows a marked increase over the figures for February, although eight plants still reported no production for the month. Shipments both by rail and truck showed a good increase. Stocks on hand decreased somewhat, but the increased demand increased the amount of unfilled orders somewhat.

The following are average prices quoted for sand-lime brick in March:

Average Prices for March

Shipping Point	Plant Price	Delivered
Boston, Mass	$12.00	$16.00
Buffalo, N. Y.	12.25	16.50
Dayton, Ohio	12.50	15.50
Detroit, Mich.	13.00@14.00	15.00@16.00
Detroit, Mich.	.....	.....
Detroit, Mich.	13.50	16.00
Flint, Mich.	11.50	.....
Grand Rapids, Mich.	12.50	.....
Hartford, Conn.	13.00	17.00
Madison, Wis.	12.50	14.00
Menominee, Mich.	11.00	13.50
Milwaukee, Wis.	10.50	13.00
Minneapolis, Minn.	10.00	12.75
Mishawaka, Ind.	11.00	.....
Pontiac, Mich.	15.50	.....
Saginaw, Mich.	12.00	.....
Sebewaing, Mich.	.....	.....
Sioux Falls, S. D.	.....	13.00
Syracuse, N. Y.	18.00	20.00
Toronto, Canada	12.50	15.00
Winchester, Mass.	.....	16.00

The following statistics are compiled from data received direct from 21 producers of sand-lime brick in the United States and Canada:

Statistics for February and March

	†February	*March
Production	7,431,500	11,432,855
Shipments (rail)	2,954,600	3,944,652
Shipments (truck)	5,942,000	9,497,929
Stocks	16,973,900	14,256,168
Unfilled orders	10,665,000	12,630,000

*Twenty-one plants reporting; incomplete, eight plants not reporting unfilled orders.

†Twenty-two plants reporting; incomplete, one plant not reporting production and eight not reporting unfilled orders.

Notes from Producers

The Sioux Falls Pressed Brick Co. of Sioux Falls, South Dakota, is furnishing brick for the Minnehaha National Bank, Chevrolet Garage (outside and solid wall of sand-lime brick) and the Sioux Valley Hospital.

The following producers have renewed operations at their respective plants: Flint Sandstone Brick Co. of Flint, Mich., commenced operating on April 1, and the Sebewaing Sandstone Brick Co. of Sebewaing, Mich., on April 9.

Strength of Sand-Lime Brick

THE Bureau of Standards, in the course of its investigation of the properties of sand-lime brick, has accumulated considerable data on the strength of the brick. However, the majority of tests of the commercial product have been made on small lots, usually 5 or 10 brick from each manufacturer, as required by the specifications. It was considered desirable to obtain additional information on the strength of the brick, and particularly on the variation in strength of the product produced by an individual manufacturer. Consequently 25 manufacturers have supplied 50 brick each, representing their regular production, for use in these tests.

After drying to constant weight, the absorption by total immersion in cold water was obtained at the 5-minute, 5-hour and 24-hour periods. The absorption on boiling for five hours was also determined. Ten of each group of 50 brick were then selected, using care to obtain a range of absorption, and these 10 were reserved for freezing tests, to determine the weathering properties of the brick. The other 40 were dried and broken transversely to determine the modulus of rupture. The compressive strength of each half of each brick was then determined, one-half having been tested on edge, the other half tested flat. The results obtained thus far show that the absorption ranged from 13.7 to 21.6% of the weight of the dry brick; the modulus of rupture from 330 to 730 lb./in.^{2}; the compressive strength, flat, from 2150 to 4470 lb./in.^{2}, and the compressive strength, on edge, from 1500 to 3850 lb./in.^{2} —*Technical News Bulletin* of the U. S. Bureau of Standards.

Snowhite Limestone Co. Formed at Pueblo, Colo.

FORMATION of a new company to supply limestone for the American and Holly sugar companies and for the Pueblo Lime Co., with which it is affiliated, has been effected in Pueblo, Colo., it was announced recently. The new concern, the Snowhite Limestone Co., was incorporated by Jay D. Thomas, manager of the Pueblo Lime Co.; Todd C. Storer, local attorney, and E. E. Thomas, of Garfield, Colo. Its capitalization was placed at 50,000 shares having no par value.

The new company will take limestone from an extensive quarry at Garfield in sufficient quantities to supply both projects. This will result in increasing the capacity of the Pueblo Lime Co. to double its present size, according to Mr. Thomas. The increased output will approximate 20 tons a day.

A new lime kiln will be constructed at the company's plant, located on East Eight St. near the railroad tracks, and the number of employes will be increased. It is expected to begin activities at the new quarry within the next 60 days and to complete the enlargement of the lime plant some time this spring.—*Pueblo* (Colo.) *Chieftain.*

Muskingum River Gravel Co. Adds Two New Boats to Its Equipment

PREDICTING a greatly stimulated demand for gravel for road construction purposes this year, the Muskingum River Gravel Co. is now completing additions to its equipment that will give it an output of 3000 tons of finished product a day. With the passage of the 4-cent gasoline tax bill, the state, counties and townships will have ample funds for improvement of roads and greater demand for sand and gravel and other materials is expected.

During the past winter the company has been dismantling some of its old equipment and constructing new equipment of larger capacity. A new derrick boat which will carry a 2-yd. clamshell bucket has recently been built by the company and launched. The hull of this boat is 32x88x50 ft. The installation of the machinery is now being made in the boat and production with it will begin in a short time.

Another new unit is a washing, screening and crushing boat. This will have a steel hull and will be powered with a 120-hp., Fairbands-Morse, full-Diesel engine. The equipment installed on this boat will consist of a large feed hopper, two large screens, two belt conveyors, three elevators, a crusher, electric light plant and electric winches. The crusher will have a capacity of 70 tons per hour and the complete boat will have a capacity of 1500 tons of finished product in 10 hours.

This new equipment together with other equipment now in use by the gravel company will give a total production capacity of 3000 tons per day.

This company has been experimenting during the past three years with various types of gravel washers to produce a product free from all objectionable material, including silt, sticks and coal, and has developed an entirely new type of machine which will successfully remove all objectionable matter.

The company will have in operation this year two complete sand and gravel units consisting of two sand and gravel washing plants, two derrick boats, two tow boats, 13 barges, six trucks and a large amount of miscellaneous equipment. Shipments are made via rail, truck or water.—*Zanesville* (Ohio) *Signal.*

Cement Products

TRADE MARK REGISTERED WITH U. S. PATENT OFFICE

Larger Markets Assure Continued Growth of the Cement Products Industry

Manufacturers Learn the Possibilities of Getting Out of the Basement with a Wider Range of Products

By Mercer R. Bowers

THE year 1928 witnessed a great deal of discussion about the country-wide prosperity among the industries of the United States. A careful study of business in general revealed in many cases that a condition known as "profitless prosperity" existed. Factories and mills were running full time but the balance sheet at the close of the fiscal year indicated that little or no profits had been made.

The reason for this condition could usually be traced back to some cause as excessive overhead, poor management, price cutting, and excessive sales and advertising expense, all or any one of which would make heavy inroads into the profits of any business.

In the concrete products industry there were plants operating on a "profitless prosperity" basis and usually the reason could be traced back to one or all of the first three above mentioned causes, but seldom, if ever, to the last one. Excessive overhead and price cutting are deadly to any industry and they have become serious problems to be solved in the business of making concrete masonry.

Business Is Increasing

The general tone of this industry, however, is good and indications are that it will be even better in 1929. The business showed an increase of 10% in production during 1928 over 1927 and the concrete products industry has become one of the established leaders in the building materials field. One of the youngest in the field, this industry has made phenomenal growth and progress during the past ten years. For instance in 1918 something like 50,000,000 units were produced. In 1928 a nation-wide survey showed an equivalent production of 387,000,000 of 8 by 8 by 16-in. units of concrete masonry. This is an increase of over 650% in ten years, ending with the year 1928.

The average concrete products manufacturer has materially changed during this period. In place of turning out a few thousand block annually on a hand machine for foundation and basement use, he now produces anywhere from 50,000 to over 2,000,000 units in a year and the greater part of this production is going into above-grade construction. Whereas the quality of his product was questionable in the early stages of the industry's development, today we find a high standard quality product produced under controlled methods.

The back yard hand machines have given way to modern plants, fully equipped to produce a quality product on an economically sound basis. In many cases manufacturers are following the lead of the steel and automobile industries by running their plants on a multiple shift basis. By doing so they are getting maximum value from their equipment by wearing it out in place of allowing it to rust out and become worthless through obsolescence. Manufacturers who are following this plan are attacking the problem of excessive overhead in an intelligent manner.

The one thing above all others that has been responsible for the miraculous growth in the concrete products industry is the fact that block men have become merchandisers as well as producers. Certainly it is this fact that caused concrete masonry to graduate from basement into above-grade construction—walls, floors and similar construction.

A concrete masonry residence in Mobile, Ala., surfaced with portland cement stucco and roofed with concrete roofing tile

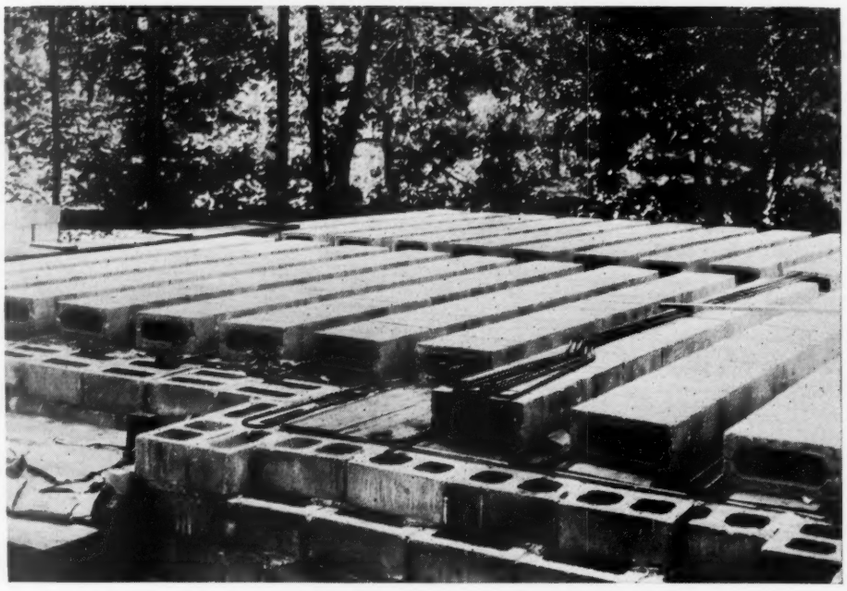
A factor that gave impetus to this move to enlarge the market for concrete products has been the continually increasing public demand for fire-safe construction in building. Aggressive manufacturers have been quick to take advantage of this demand. Countless tests in laboratories, in actual fires, and in fire demonstrations have proved that concrete block and building tile will withstand heat temperatures greater than are ever experienced in the average fire. In addition these building units possess high compressive strengths and low absorption. It is these qualities that have justified the extensive use of concrete masonry in all types of firesafe construction, both residential and commercial.

Fire-safe Qualities Have Helped to Enlarge the Products Field

When a building is 100% *fire-safe*, that means that interior partion walls as well as main bearing walls are built of fire-restrictive materials likewise. Thus it is readily seen that there is a place for concrete products in every section of a building from basement to roof. The market is not limited to foundations as was formerly thought. Today it covers the entire job. However it takes real merchandising ability to sell the completed structure to a prospect in place of one part of the entire unit.

An excellent example of concrete products merchandising recently took place in Cleveland, Ohio. Don A. Loftus, president of the Parma Heights Development Co. in that city, planned the construction of several hundred houses which he aptly calls "Permanesque Homes." He built excellently designed houses, architecturally speaking, on good sized lots, with all improvements in and a two-car garage added for good measure, for prices beginning at $9,900. That figure included everything, land house, improvements and all.

These houses are not cheap. Mr. Loftus used what ordinarily are called "expensive" methods and materials. The first floors are of concrete, the sort of construction usually found only in high class-class commercial buildings, such as hotels, apartments and similar structures. Concrete masonry was used in the walls.



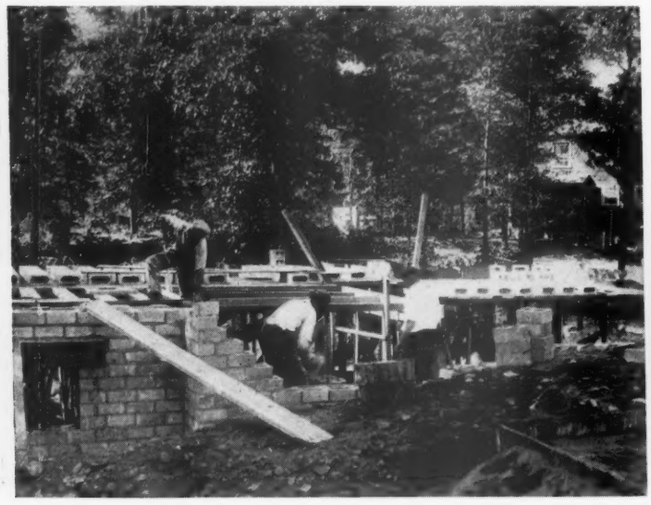
Rows of concrete tile in tile-and-joist floor construction. The spaces between the rows of tile, when filled with concrete, become the floor joists

A concrete products manufacturer, learning of Mr. Loftus's plan to build these houses, went to him, and in the face of real competition from a competitive material, he sold Mr. Loftus on concrete masonry for his Parma Heights development on the basis of permanence, fire-safety, and economy. To accomplish this he certainly had to know building costs and estimates. Full development of markets such as this one in Cleveland will mean greater profits for the products manufacturer and continued growth for the concrete products industry.

A factor that is greatly influencing the daily lives of the American public is style. We buy nearly everything today with style very much in mind, clothes, automobiles and even our homes. Architects discovered that concrete masonry with other concrete products, perfectly satisfies every modern building requirement in this connection. No matter what the style or form it usually can be worked out in terms of concrete block, tile, architectural ornament, stucco, and roofing tile.

Style Is an Important Factor

Many products men have been able to increase the market for their products by keeping this factor of style in mind. They are producing various types and sizes of units that are easily adaptable to many styles of architecture. Highly acceptable as a back-up material for portland cement stucco, these masonry units may also be used with pleasing effect by leaving the surface

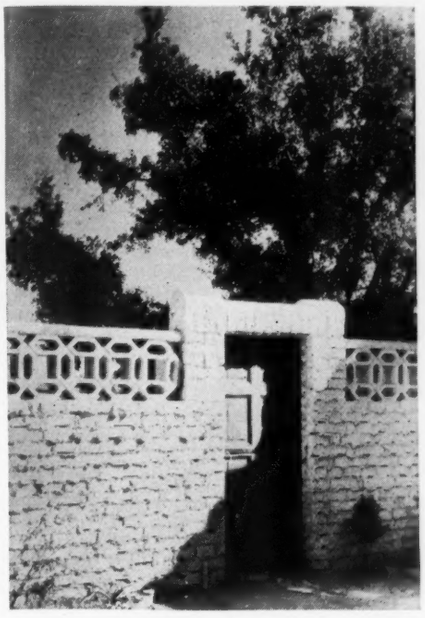


Workman erecting forms for a concrete floor of the tile-and-joist type in which concrete tile are used

A firesafe garage built of concrete block covered with portland cement stucco. Concrete tile roof adds firesafety

exposed. The use of a variety of standard sizes and textures in concrete masonry for wall construction produces an effect known as random ashlar, in other words a wall built of square or rectangular stones of varying sizes.

Last year for the first time in history concrete masonry entered the skyscraper market as a building material. This took place in the city of Philadelphia where at the present time many hundred thousands of concrete masonry units, block, brick, and



An artistic wall of concrete masonry. The studied effect of old mortar joints lends additional beauty to this garden

tile are being used on major building projects of the skyscraper class. It took merchandising of the highest type to open up this field and there is little doubt but that in time the skyscraper will become one of the most important market possibilities for the products manufacturer in our large cities.

Another important market that has been only recently exploited is the man-hole and catch-basin block business. As the cities and towns in the United States continue to grow and prosper there is an ever increasing need for larger and more extensive sewage disposal systems. This means thousands of miles of sewers must be laid annually and for every mile of sewers there will be built from 12 to 18 manholes of varying depths. Many curb catch basins are likewise required and in some cities the law requires that house catch basins must also be built. If these manholes and catch basins are built of concrete block this means a market for from 2500 to 25,000 units per mile of sewer.

Concrete units designed for manhole and catch basin construction have horizontal cross-sections in the form of a segment of a circle, and are 6 to 8 in. in height, and 6 in. in thickness. For the height 6 in. is preferable because of the difficulty of handling the larger unit with its extra weight. Either tongue and groove or double joints at the ends of each segment make them rigidly interlocking when laid in the wall, giving the wall strength and rigidity of a monolithic structure.

Individual units are so shaped that seven of them are required for a structure having a 30-in. inside diameter, eight units for 36-in., nine for 42-in., and ten for 48-in. This makes all units of approximately the same size and weight, making them all uniformly easy to handle and lay.

Those manufacturers who have undertaken to develop this market in their communities have found it a profitable business. Such a step does not necessarily mean a complete new layout of equipment, because the same machines, trucks, curing chambers, etc., can be used by simply changing the mold boxes and pallets.

The initial work of promoting manhole and catch basin block must be taken up with the city and county engineers because nearly all sewer construction is a municipal affair and these officials are directly responsible for the completed job and for specifying the type of material to be used. Sewer contractors, once they are familiar with the advantages of concrete manhole block, are glad to help in every way possible to have this material written into the specifications because they have found that a saving of 50% in labor and 45% to 50% in mortar can be effected with concrete block in place of brick.

Thus we see that there is little possibility of a saturation point being reached in the markets for concrete products. Some of the largest and in time to become the most important have scarcely been touched.

F. R. Zaugg Resigns as Secretary of the Northwest Concrete Products Association

ANNOUNCEMENT has just been received that F. R. Zaugg, executive secretary of the Northwest Concrete Productsucts Association, has resigned from that office. Mr. Zaugg has not made known his plans for the future as yet. In the work of building up the concrete products industry in the Pacific Northwest, Mr. Zaugg has been untiring and his resignation will mean a real loss to the association. At present the Northwest Concrete Products Association is one of the most active regional groups in the industry. One of its principal activities, and one for which Mr. Zaugg is largely responsible, is the development of research work in the concrete products field.

Tests of Cast Stone

THE Bureau of Standards has determined the absorption of numerous samples of cast stone. In connection with this work it has been suggested that the absorption may be due to a low dry weight of the sample caused by partial dehydration of some of the colloidal material present in the stone when the latter is dried at temperatures as high as 110 deg. C. It is also possible that high absorptions may result from boiling the sample for the total absorption, thus producing continued hydration of some of the cement which has not set.

With these possibilities in mind, the following method of absorption was tried. Cores were cut from each of 12 typical samples. These were maintained at 35 deg. C.

Concrete block manhole in Grant Park, Chicago, illustrating the use of batter block for the top courses

in dry air until a loss of not more than 0.05% in four hours was obtained. The specimens were then totally immersed in 300 deg. mineral seal oil and the absorption noted over a period of 48 hours. Then the specimens and oil were placed in a closed chamber, the pressure reduced and maintained at 4 mm. mercury for five hours. The absorptions were then calculated to the equivalent of water as per cent of dry weight of specimens. The specimens absorbed from 1.6 to 9.3% in 48 hours, one specimen being below 2%. After reducing the pressure to 4 mm. the absorptions ranged from 2.2 to 13.4%.

Thus, even under conditions where the possibility of dehydration is reduced and the rehydration eliminated, cast stone does absorb a considerable quantity of water and the absorption test, as generally carried out, using water, is a fair measure of the pore space of the stone.—*Technical News Bulletin* of the U. S. Bureau of Standards.

The Rock Products Market

Wholesale Prices of Crushed Stone

Prices given are per ton, F.O.B., at producing point or nearest shipping point

Crushed Limestone

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
EASTERN:						
Buffalo, N. Y.	1.30	1.30	1.30	1.30	1.30	1.30
Chaumont, N. Y.	.50	1.75	1.75	1.50	1.50	1.50
Chazy, N. Y.	.75	1.75	1.60	1.30	1.30	1.30
Dundas, Ont.	.53	1.05	1.05	.90	.90	.90
Farmington, Conn.	.....	1.30	1.10	1.00	1.00	.....
Frederick, Md.	.50–.75	1.35–1.45	1.15–1.25	1.10–1.20	1.05–1.15	1.05–1.10
Ft. Springs, W. Va.	.40	1.25	1.25	1.25	1.15	1.15
Munns, N. Y.	1.00	1.25	1.25	1.15	1.00	.....
Prospect, N. Y.	.80	1.25	1.15	1.15	1.15	.....
Rochester, N. Y.—Dolomite	1.50	1.50	1.50	1.50	1.50	1.50
St. Vincent de Paul, Que. (n)	.70	1.50	1.50	1.00–1.25	.95	.90
Syracuse, N. Y.	.50	.....	1.00	1.00	1.00	1.00
Walford, Penn.	.....	.....	1.35h	1.35h	1.35h	1.35h
Watertown, N. Y.	1.00	1.75	1.75	1.50	1.50	1.50
West Chester, Penn.	5.00g	.....	.....	.....	.....	4.00k
Western New York	.85	1.25	1.25	1.25	1.25	1.25
CENTRAL:						
Afton, Mich.	.....	.....	.....	.....	.50	1.50
Alton, Ill.	1.85	.....	.....	.....	.....	.....
Columbia and Krause, Ill.	1.05–1.40	.95–1.50	1.15–1.50	1.05–1.50	1.05–1.50	.....
Cypress, Ill.	.90–1.15	.90–1.15	1.00–1.15	1.00–1.20	1.00–1.15	1.00
Davenport, Iowa (f)	1.00	1.50	1.50	1.30	1.30	1.40
Dubuque, Iowa	.95	1.10	1.10	1.10	1.10	1.10
Stolle and Falling Springs, Ill.	1.05–1.40	.95–1.50	1.15–1.50	1.05–1.50	1.05–1.50	.....
Greencastle, Ind.	1.25	1.05	1.05	1.05	1.05	1.05
Lannon, Wis.	1.00	1.00	1.00	.90	.90	.90
McCook, Ill.	1.00	1.25	1.25	1.25	1.25	1.25
Marblehead, Ohio (l)	.55	.80	.80	.80	.80	.80
Milltown, Ind.	.....	.90–1.00	1.00–1.10	.90–1.00	.85–.90	.85–.90
Northern Ohio points	.85–1.15	1.25	1.15	1.15	1.15	1.15
Sheboygan, Wis.	1.10	1.10	1.10	1.10	1.10	1.10
Stone City, Iowa	.75	.....	1.20	1.00	1.00	.....
Thornton, Ill.	.90	1.00	1.25	1.25	1.25	1.25
Toledo, Ohio	1.10	1.70	1.70	1.70	1.70	1.70
Toronto, Canada	2.50	3.00	3.00	2.85	2.85	2.85
Valmeyer, Ill. (fluxing limestone)	.90–1.20	.....	.....	1.75	.....	1.75
Waukesha, Wis.	.....	.90	.90	.90	.90	.....
Winona, Minn.	1.00	1.20	1.30	1.40	1.40	1.40
Wisconsin points	.50	.....	1.00	.90	.90	.....
Youngstown, Ohio	1.00	1.00	1.25	1.25	1.25	1.25
SOUTHERN:						
Cartersville, Ga.	1.35	1.65	1.65	1.45	1.15	.....
Chico, Texas	.50	.50	1.25	1.15	1.10	1.00
Cutler, Fla.	.60r	.....	.....	1.75r	1.10r	.....
El Paso, Tex.	.50–1.25r	1.00–1.50	1.00–1.75	1.00–1.75	1.00–1.75	.....
Graystone, Ala.	Crusher run, screened, $1 per ton					
Olive Hill, Ky.	1.00	1.00	1.00	1.00	.90	.90
Rocky Point, Va.	.50–.75	1.40–1.60	1.30–1.40	1.15–1.25	1.10–1.20	1.00–1.05
WESTERN:						
Atchison, Kan.	.50	1.80	1.80	1.80	1.80	1.80
Blue Springs and Wymore, Neb.	.25	1.45	1.45	1.35c	1.25d	1.20
Cape Girardeau, Mo.	1.00	1.25	1.25	1.25	1.00	.....
Rock Hill, St. Louis, Mo.	1.45	1.45	1.45	1.45	1.45	1.45

Crushed Trap Rock

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Birdsboro, Penn. (q)	1.20	1.60	1.45	1.35	.....	1.30
Branford, Conn.	.80	1.70	1.45	1.20	1.05	.....
Eastern Maryland	1.00	1.60	1.60	1.50	1.35	1.35
Eastern Massachusetts	.85	1.75	1.75	1.25	1.25	1.25
Eastern New York	.75	1.25	1.25	1.25	1.25	1.25
Eastern Pennsylvania	1.10	1.70	1.60	1.50	1.35	1.35
Knippa, Tex.	2.50	2.25	1.60	1.35	1.25	1.25–2.00
New Britain, Plainville, Rocky Hill, Wallingford, Meriden, Mt. Carmel, Conn.	.80	1.70	1.45	1.20	1.05	.....
Northern New Jersey	1.35–1.40	1.40–2.10	1.90	1.50	1.50	.....
Richmond, Calif.	.75	.....	1.00	1.00	1.00	.....
Spring Valley, Calif.	.90–1.25	.90–1.25	.90–1.25	.90–1.25	.90–1.25	.90–1.25
Springfield, N. J.	1.40	2.00	1.90	1.60	1.60	.....
Toronto, Canada	.....	5.80	4.05	4.05	.....	.....
Westfield, Mass.	.60	1.35	1.25	1.10	1.00	1.00

Miscellaneous Crushed Stone

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Berlin, Utley, Montello and Red Granite, Wis.—Granite	1.80	1.70	1.50	1.40	1.40	.....
Cayce, S. C.—Granite	.....	.....	1.75	1.60	1.60	.....
Eastern Pennsylvania—Sandstone	1.35	1.70	1.65	1.40	1.40	1.40
Eastern Pennsylvania—Quartzite	1.20	1.35	1.25	1.20	1.20	1.20
Emathla, Fla.—Flint rock	1.00	.....	2.35	.....	.....	.....
Lithonia, Ga.—Granite	.75a	2.00b	1.75	1.35	1.25	1.25
Lohrville, Wis.—Granite	1.65	1.70	1.65	1.45	1.50	.....
Middlebrook, Mo.	3.00–3.50	.....	2.00–2.25	2.00–2.25	.....	1.25–3.00
Richmond, Calif.—Quartzite	.75	.....	1.00	1.00	1.00	.....
Somerset, Penn. (sand-rock)	1.50 to 1.85					
Toccoa, Ga.—Granite	.....	1.40	1.40	1.35	1.25	1.25

(a) Sand. (b) ½ to ⅞ in. (c) 1 in., 1.40. (d) 2 in., 1.30. (e) Price net after 10c cash discount deducted. (f) 1 in. to ¼ in., 1.45; 2 in. to ¾ in., 1.35. High calcite fluxing stone, 1.50. (g) Run of quarry. (h) Less 10c discount. (j) Less 10% net ton. (k) Rubble stone. (l) Less .05. (n) Ballast R. R., .90; run of crusher, 1.00. (p) Carloads prices. (q) Crusher run, 1.40; ¼-in. granolithic finish, 3.00. (r) Cubic yard.

Agricultural Limestone

(Pulverized)

Alton, Ill.—Analysis, 98% $CaCO_3$, 0.01% $MgCO_3$; 90% thru 100 mesh	4.00
Bettendorf and Moline, Ill.—Analysis, $CaCO_3$, 97%; 2% $MgCO_3$; 50% thru 100 mesh, 1.50; 50% thru 4 mesh	1.50
Blackwater, Mo.—100% thru 4 mesh	1.00
Branchton, Penn.—Analysis, 94.89% $CaCO_3$; 1.5% $MgCO_3$; 50% thru 100 mesh	3.50–5.00
Cape Girardeau, Mo.—Analysis, $CaCO_3$, 94½%; $MgCO_3$, 3½%; 90% thru 50 mesh	1.50
Cartersville, Ga.—90% thru 100 mesh, 2.00; 50% thru 50 mesh	1.50
Chaumont, N. Y.—Pulverized limestone, bags, 4.00; bulk	2.50
Cypress, Ill.—Analysis, 95% $CaCO_3$, 2% $MgCO_3$; 90% thru 100 mesh, 1.35; 50% thru 100 mesh, 1.15; 90% thru 50 mesh, 1.15; 50% thru 50 mesh, 1.05; 90% thru 4 mesh, 1.10; 50% thru 4 mesh	1.00
Danbury, Conn., and West Stockbridge, Mass.—Analysis, 90% $CaCO_3$; 5% $MgCO_3$; fine ground, 90% thru 100 mesh; bulk	3.50
Paper bags	4.75
100-lb. cloth bags	5.25
(All prices less .25 cash 15 days)	
Davenport, Ia.—Analysis, 97% $CaCO_3$; 2% and less $MgCO_3$; 90% thru 200 mesh, bags, per ton	6.00
90% thru 20 mesh, bulk, per ton	1.50
Hillsville, Penn.—Analysis, 94% $CaCO_3$; 1.40% $MgCO_3$; 75% thru 100 mesh; sacked	5.00
Hot Springs and Greensboro, N. C.—Analysis, $CaCO_3$, 98-99%; $MgCO_3$, 42%; pulverized; 67% thru 200 mesh; bags	3.95
Bulk	2.70
Jamesville, N. Y.—Analysis, 89% $CaCO_3$, 4% $MgCO_3$; pulverized; bags, 4.25; bulk	2.75
Joliet, Ill.—Analysis, 52% $CaCO_3$; 48% $MgCO_3$; 90% thru 100 mesh	3.50
Knoxville, Tenn.—80% thru 100 mesh; bags, 3.95; bulk	2.70
Marlbrook, Va.—Analysis, 80% $CaCO_3$; 10% $MgCO_3$; bulk	1.75
Marl—Analysis, 95% $CaCO_3$; 0% $MgCO_3$; bulk	2.25
Marion, Va.—Analysis, 90% $CaCO_3$, 2% $MgCO_3$; per ton	2.00
Middlebury, Vt.—Analysis, 99.05% $CaCO_3$; 90% thru 50 mesh	4.50
Milltown, Ind.—Analysis, 94.50% $CaCO_3$, 33% thru 50 mesh, 40% thru 50 mesh; bulk	1.35–1.60
Olive Hill, Ky.—Analysis, $CaCO_3$ 94-98%; 50% & 90% thru 4 mesh	1.00
Piqua, Ohio—Total neutralizing power 101.12%; 60% thru 100 mesh	2.50
100% thru 10, 90% thru 50, 70% thru 100; bags, 5.00; bulk	3.50
100% thru 4, 30% thru 100, bulk	1.50
Rocky Point, Va.—Analysis, $CaCO_3$, 97%; $MgCO_3$, 75%; 50% thru 200 mesh, burlap bags, 3.50; paper, 3.25; bulk	2.00
Watertown, N. Y.—Analysis, 53.72% $CaCO_3$; pulverized; sacks, 4.25; bulk	2.75

Agricultural Limestone

(Crushed)

Bedford, Ind.—Analysis, 98% $CaCO_3$; 1%, $MgCO_3$; 90% thru 10 mesh	1.50
30% thru 100 mesh	1.50

(Continued on next page)

Agricultural Limestone

Chico and Bridgeport, Tex. — Analysis, 95% $CaCO_3$; 1.3% $MgCO_3$; 90% thru 4 mesh 1.00–1.25

Charles-Town, W. Va.—Lime Marl—Analysis, 95% $CaCO_3$, 50% thru 100 mesh, bulk, 3.00; including burlap bags 4.50

Davenport, Ia.—Analysis, 97% $CaCO_3$; 2% and less $MgCO_3$; 90% thru 10 mesh, per ton 1.25
90% thru 4 mesh, per ton 1.10

Dubuque, Iowa—Analysis, 54% $CaCO_3$; 38% $MgCO_3$; 50% thru 4 mesh ..... .95

Dundas, Ont.—Analysis, 54% $CaCO_3$; $MgCO_3$, 43%; 50% thru 50 mesh 1.00

Ft. Spring, W. Va. — Analysis, 90% $CaCO_3$; 50% thru 50 mesh 1.50

Kansas City, Mo.—50% thru 100 mesh 1.00

Lannon, Wis.—Analysis, 54% $CaCO_3$, 44% $MgCO_3$; 99% thru 10 mesh; 46% thru 60 mesh 2.00
Screenings (¼ in. to dust) 1.00

Marblehead, Ohio—90% thru 100 mesh 3.00
90% thru 50 mesh 2.00
90% thru 4 mesh 1.00

McCook, Ill.—90% thru 4 mesh ..... .90

Middlepoint, Bellevue, Bloomville, Kenton and Whitehouse, Ohio; Monroe, Mich.; Bluffton, Greencastle and Kokomo, Ind. —85% thru 10 mesh, 25% thru 100 mesh 1.50

Moline, Ill., and Bettendorf, Iowa—Analysis, 97% $CaCO_3$, 2% $MgCO_3$; 50% thru 100 mesh; 50% thru 4 mesh 1.50

Mountville, Va. — Analysis, 76.60% $CaCO_3$; $MgCO_3$, 22.83%, 100% thru 20 mesh; 50% thru 100 mesh, paper bags, 4.50; burlap bags 5.00

Stolle and Falling Springs, Ill.—Analysis, 89.9% $CaCO_3$, 3.8% $MgCO_3$; 90% thru 4 mesh 1.10–1.70

Stone City, Iowa — Analysis, 98% $CaCO_3$; 50% thru 50 mesh ..... .75

Waukesha, Wis.—90% thru 100 mesh, 4.50; 50% thru 100 mesh 2.10

Valmeyer, Ill.—Analysis, 96% $CaCO_3$, 2% $MgCO_3$; 100% thru 10 mesh 1.10–1.70

Pulverized Limestone for Coal Operators

Davenport, Ia.—Analysis 97% $CaCO_3$; 2% and less $MgCO_3$; 100% thru 20 mesh, 50% thru 200 mesh; paper sacks 6.00
Hillsville, Penn., sacks, 5.10; bulk 3.50

Joliet, Ill.—Analysis, 52% $CaCO_3$; 48% $MgCO_3$; 95% thru 100 mesh; paper bags (bags extra) 3.50

Marblehead, Ohio — Analysis, 83.54% $CaCO_3$; 14.92% $MgCO_3$; 99.8% thru 100 mesh; sacks 4.25
Piqua, Ohio—99% thru 100 mesh, bulk, 3.50; in 80-lb. bags (f.o.b. Piqua) 5.00

Rocky Point, Va.—Analysis, 97% $CaCO_3$; 75% $MgCO_3$; 85% thru 200 mesh, bulk 2.25–3.50

Waukesha, Wis.—90% thru 100 mesh, bulk 4.00

Glass Sand

Silica sand is quoted washed, dried and screened unless otherwise stated. Prices per ton f.o.b. producing plant.

Cedarville and S. Vineland, N. J. *1.75–2.25
Estill Springs and Sewanee, Tenn. 1.50
Franklin, Penn. 2.00
Klondike, Mo. 2.00
Massillon, Ohio 3.00
Michigan City, Ind. ..... .30– .35
Ohlton, Ohio 2.50
Ottawa, Ill. 1.25
Red Wing, Minn. 1.50
Rockwood, Mich. 2.25–3.00
San Francisco, Calif. 4.00–5.00
Silica and Mendota, Va. 2.00–2.50
St. Louis, Mo. 2.00
Utica and Ottawa, Ill. 75–1.00
Zanesville, Ohio 2.50

Miscellaneous Sands

City or shipping point	Roofing sand	Traction
Beach City, Ohio	.....	1.50
Dresden, Ohio	.....	1.25
Eau Claire, Wis.	4.30	1.00–1.25
Estill Springs and Sewanee, Tenn.	1.35–1.50	1.35–1.50
Franklin, Penn.	.....	1.75
Massillon, Ohio	.....	2.00
Michigan City, Ind.	.....	.30
Montoursville, Penn.	.....	1.25
Ohlton, Ohio	1.75	1.75
Ottawa, Ill.	3.25	1.25
Red Wing, Minn.	.....	1.00
San Francisco, Calif.	3.50	3.50
Silica, Va.	.....	1.75

(Continued on next page)

Wholesale Prices of Sand and Gravel

Prices given are per ton, F.O.B., producing plant or nearest shipping point

Washed Sand and Gravel

City or shipping point	Fine Sand, 1/10 in. down	Sand, ¼ in. and less	Gravel, ½ in. and less	Gravel, 1 in. and less	Gravel, 1½ in. and less	Gravel, 2 in. and less
EASTERN:						
Asbury Park, Farmingdale, Spring Lake and Wayside, N. J.	.50	.50	1.15	1.25	1.25	.....
Attica and Franklinville, N. Y.	1.00	1.00	1.00	1.00	1.00	1.00
Boston, Mass.†	1.40	1.40	2.25	.....	2.25	2.25
Buffalo, N. Y.	1.10	1.05	1.05	1.05	1.05	1.05
Erie, Penn.	.60	.85	1.30	.....	1.30	.....
Leeds Junction, Me.	.....	.50	1.75	.....	1.25	1.00
Machias Jct., N. Y.	.75	.75	.75	.....	.75	.75
Milton, N. H.	.....	.50	.....	.....	.....	.90
Montoursville, Penn.	1.00	.75	.80	.75	.70	.70
Northern New Jersey	.....	.30– .50	.....	.75–1.25	.75–1.25	.....
Somerset, Penn.	.....	2.00	.....	.....	.....	.....
South Portland, Me.	.....	1.00	2.25	.....	.....	2.25
Troy, N. Y.	.50– .75*	.50– .75*	.80–1.00*	.80–1.00*	.....	.80–1.00*
F. o. b. boat, per yd.	1.50	1.50	1.75	1.75	.....	1.75
Washington, D. C.	.55	.55	1.20	1.20	1.20	1.00
CENTRAL:						
Algonquin, Ill.	.50	.35	.25	.45	.45	.50
Attica, Ind.			All sizes .75–.85			
Aurora, Moronts, Oregon, Sheridan, Yorkville, Ill.	.50	.35	.20	.50	.60	.60
Barton, Wis.	.....	.40s	.65s	.65s	.65s	.65s
Chicago, Ill.	.50	.50–1.45n	.60	.60–1.55n	.60	.60–1.90z
Chicago, Ill.	.30	.20	.30	.40	.40	.45
Columbus, Ohio	.....	.....	.70‖	.70‖	.70‖	.....
Des Moines, Iowa	.....	.60	1.50	1.50	1.50	1.50
Eau Claire, Chippewa Falls, Wis.	.55	.55	.70	1.00	1.00	.....
Elkhart Lake, Wis.	.60	.30	.30	.50	.50	.50
Ferrysburg, Mich.	.....	.50– .80	.60–1.00	.60–1.00	.....	.50–1.25
Grand Haven, Mich.	.....	.60	.....	.90	.....	.90
Grand Rapids, Mich.	.50	.50	.90	.80	.70	.70
Hamilton, Ohio	.....	.60– .80	.60– .80	.....	.60– .80	.60– .80
Hersey, Mich.	.....	.50	.....	.....	.....	.70
Humboldt, Iowa	.50	.50	1.40	1.40	1.40	1.40
Indianapolis, Ind.	.50– .60	.50– .60	.60– .75	.60– .75	.60– .75	.60– .75
Mankato, Minn.	.55	.45	1.25	1.25	1.25h	.....
Mason City, Iowa	.50	.50	.85	1.25	1.25	1.25
Mattoon, Ill.			.75–.85 all sizes			
Milwaukee, Wis.	.91	.91	1.06	1.06	1.06	1.06
Minneapolis, Minn. (g)	.35	.35	1.25	1.25	1.25	1.25
St. Louis, Mo. (b)	1.30e	1.30f	1.55t	1.55	1.55	1.65
St. Louis, Mo.†	2.00e	2.00f	2.25t	2.25	2.25	2.35
St. Paul, Minn.	.35	.35	.....	1.25	1.25	1.25
Terre Haute, Ind.	.75	.60	.75	.90	.75	.75
Waukesha, Wis.	.....	.45	.60	.60	.65	.65
Winona, Minn.	.40	.40	.50	1.10	1.10	1.25
SOUTHERN:						
Brewster, Fla.	.50	.50	.....	.....	.....	.....
Brookhaven, Miss.	1.25	.70	1.25	1.00	.70	.70
Charleston, W. Va.			River sand and gravel, all sizes, 1.40			
Eustis, Fla.	.....	.50	.....	.....	.....	.....
Ft. Worth, Texas	1.00–1.15	1.00–1.15	1.00–1.10	1.00–1.35	1.10–1.35	1.00–1.25
Knoxville, Tenn.	1.00	1.00	1.20	1.20	1.20	1.00
Macon, Ga.	.65– .90	.65– .90	2.25–2.50	2.25–2.50	2.25–2.50	2.25–2.50
New Martinsville, W. Va.	1.10	1.00	.....	1.30	1.10	.90
Roseland, La.	.30	.30	1.00	1.25	.80	.....
WESTERN:						
Kansas City, Mo.	.70– .80	.70– .75	.....	.....	.....	.....
Crushton, Durbin, Kincaid, Largo, Rivas, Calif.	.10– .40	.10– .40	.50–1.00	.50–1.00	.50–1.00	.50–1.00
Los Angeles, Calif.	.30	.30	.80	.80	.80	.80
Oregon City, Ore.			All grades range from 1.00 to 1.25 per cu. yd.			
Otay, Calif.	.....	.35– .40	.50– .60	.50– .60	.50– .60	.50– .60
Phoenix, Ariz. (k)	1.25*	1.15*	1.50*	1.15*	1.15*	1.00*
Pueblo, Colo.	.70	.60	.....	1.20	.....	1.15
Seattle, Wash.	1.25*	1.25*	1.25*	1.25*	1.25*	1.25*
Steilacoom, Wash.	.50	.50	.50	.50	.50	.50

Bank Run Sand and Gravel

City or shipping point	Fine Sand, 1/10 in. down	Sand, ¼ in. and less	Gravel, ½ in. and less	Gravel, 1 in. and less	Gravel, 1½ in. and less	Gravel, 2 in. and less
Algonquin and Beloit, Wis.	.....	.....	.40	.....	.....	.....
Brookhaven, Miss.	.....	.....	.....	.....	.....	.60
Buffalo, N. Y.	1.10	.95	.....	.85	.....	.95
Burnside, Conn.	.....	.75*	.....	.....	.....	.....
Chicago, Ill.	1.25m	.....	.....	.35	.....	.....
Des Moines, Iowa	.....	.75	.....	.....	.....	.....
Dresden, Ohio	.....	.....	.....	.70	.65	.....
Eau Claire, Chippewa Falls, Wis.	.....	.....	.....	.....	.65	.....
Fort Worth, Texas	.....	.....	.....	.....	.....	.75–1.00
Gainesville, Tex.	.....	.....	.....	.....	.55	.....
Grand Rapids, Mich.	.....	.....	.....	.50	.....	.....
Hamilton, Ohio	.....	.....	.....	.....	.35– .50	.....
Hersey, Mich.	.....	.....	.....	.50	.....	.....
Indianapolis, Ind.			Mixed gravel for concrete work, at .65			
Macon, Ga.	.35	.....	.....	.....	.....	.....
Mankato, Minn.	.70	.....	.....	.....	.....	.....
Oregon City, Ore.	1.25*	1.25*	1.25*	1.25*	1.25*	1.25*
Roseland, La.	.....	.....	.....	.60	.60	.60
Somerset, Penn.	.....	1.85–2.00	.....	1.50–1.75	.....	.....
Steilacoom, Wash.	.25	.....	.....	.....	.....	.....
St. Louis, Mo.			Mine run gravel, 1.55 per ton			
Summit Grove, Ind.	.50	.50	.50	.50	.50	.54
Winona, Minn.	.....	.....	.....	.....	.....	.60
York, Penn.	1.10	1.00	.....	.....	.....	.....

*Cubic yd. †Delivered on job by truck. (a) ⅝-in. down. (b) 1½- to ¼-in., 1.65. (c) 2½-in. and less. (d) By truck only. (d) Delivered in Hartford, Conn., $1.50 per yd. (e) Mississippi River. (f) Meramee River. (g) Per yd., del. by truck, ¼-in. down, 1.25; 2 in. and less, 2.40. (h) ¾-in. and larger. (j) Lake sand, 1.75, delivered. (k) 60–70% crushed boulders. (m) Cu. yd., dune sand, f.o.b. cars, Chicago. (n) Cu. yd., f.o.b. cars, Chicago. (r) Pit run. (s) Plus 15c for winter loading. (t) Fine and regular binder. (u) Coarse, torpedo, also roofing. (v) Coarse binder. †2% discount if paid by 15th of month following delivery.

Core and Foundry Sands

Silica sand is quoted washed, dried and screened unless otherwise stated. Prices per ton f.o.b. producing plant.

City or shipping point	Molding, fine	Molding, coarse	Molding, brass	Core	Furnace lining	Sand blast	Stone sawing
Albany, N. Y.	2.00	2.00	2.00	1.00–2.25		1.50–3.50	
Beach City, Ohio	1.75	1.75		1.50	1.50		
Dresden, Ohio	1.25–1.50	1.25–1.50	1.50–1.75	1.00–1.25			
Eau Claire, Wis.						3.00	
Elco and Murphysboro, Ill.	Water-floated ground silica per ton in carloads—18.00–31.00						
Estill Springs and Sewanee, Tenn.	1.25			1.25		1.35–1.50	
Franklin, Penn.	2.00	1.75		1.75			
Kasota, Minn.							1.00
Kerrs, Ohio	1.10–1.50	1.25–2.00	2.00			2.75–3.00	
Klondike, Mo.	2.00			2.00			
Massillon, Ohio	2.25	2.25		2.25	2.50		
Michigan City, Ind.				.30– .35			
Montoursville, Penn.				1.50–1.60			
New Lexington, Ohio	2.00	1.50					
Ohlton, Ohio	1.75	1.75		2.00	1.75	1.75	
Ottawa, Ill.	1.25	3.00	1.25	1.25	1.25	3.50	3.00
Red Wing, Minn. (d)					1.50	3.00	1.50
San Francisco, Calif.[1]	3.50†	5.00†	3.50†	3.50–5.00†	3.50–5.00†	3.50–5.00†	
Silica, Mendota, Va.	Potters sand, 8.00–10.00g						1.75
Utica and Ottawa, Ill.	.40–1.00f	.40–1.00f	.75–1.00	.40–1.00f	.60–1.00f	2.23–3.25	1.00–3.25
Utica, Ill.	.60	.70		.75	1.00		
Warwick, Ohio	1.50*–2.00h	1.50*–2.00h		1.50*–2.00h			
Zanesville, Ohio	2.00	1.50	2.00	2.50	2.00		

*Green. †Fresh water washed, steam dried. [1]Core, washed and dried, 2.50. (d) Filter sand, 3.00. (e) Filter sand, 3.00–4.25. (f) Crude and dry. (g) Also 12.00; building sand, 1.75–2.00. (h) Washed, 1.75.

Crushed Slag

City or shipping point EASTERN:	Roofing	¼ in. down	½ in. and less	¾ in. and less	1½ in. and less	2½ in. and less	3 in. and larger
Buffalo, N. Y., Erie and Dubois, Penn.	2.25	1.25	1.25	1.35	1.25	1.25	1.25
Eastern Penn.	2.50	1.20	1.50	1.20	1.20	1.20	1.20
Northern New Jersey	2.50	1.20	1.50	1.20	1.20	1.20	1.20
Reading, Penn.	2.50	1.25		1.50			
Western Pennsylvania	2.50	1.25	1.50	1.25	1.25	1.25	1.25
CENTRAL:							
Ironton, Ohio		1.30*		1.45*	1.45*	1.45*	
Jackson, Ohio	2.05*	1.05*	1.80*	1.30*	1.05*	1.30*	1.30*
Toledo, Ohio	1.50	1.10	1.25	1.25	1.25	1.25	1.25
SOUTHERN:							
Ashland, Ky.	2.05*	1.45*	1.80*	1.45*	1.45*	1.45*	1.45*
Ensley and Alabama City, Ala.	2.05	.55	1.25	1.15	.90	.90	.80
Longdale, Roanoke, Ruesens, Va.	2.50	1.00	1.25	1.25	1.25	1.15	1.05
Woodward, Ala.†	2.05	.55*		1.15*	.90*	.90*	

5c per ton discount on terms. †1¼ in. to ¾ in., $1.05; ⅝ in. to 10 mesh, $1.25*; ⅝ in. to 0 in., .90*; ¾ in. to 10 mesh, .80*.

Lime Products (Carload Prices Per Ton F.O.B. Shipping Point)

EASTERN:	Finishing hydrate	Masons' hydrate	Agricultural hydrate	Chemical hydrate	Ground burnt lime, Blk.	Ground burnt lime, Bags	Lump lime, Blk.	Lump lime, Bbl.
Berkeley, R. I.			12.00					2.00
Buffalo, N. Y.	11.50	7.50	7.50	12.00	8.00	11.00	7.50	1.50[16]
Lime Ridge, Penn.							5.00	
West Stockbridge, Mass.	12.00	10.00	5.60					2.00[13]
Williamsport, Penn.	10.00–11.00	8.50–9.00	8.50–9.00		7.00	9.00	5.00	
York, Penn., & Oranda, Va.	11.50[7]	8.50–9.50[7]	8.50–9.50[7]	8.50–10.50[7]	8.00	9.25	7.00	1.40[6]
CENTRAL:								
Afton, Mich.						10.00	7.50	
Carey, Ohio	11.50	7.50	7.50		8.00		7.50	1.50
Cold Springs, Ohio		7.50	7.50				8.00	
Gibsonburg, Ohio	11.50		7.50		8.00	10.00	8.00	
Huntington, Ind.	11.50	7.50	7.50	12.00	8.00	11.00	7.50	1.50[16]
Luckey, Ohio	11.50							
Milltown, Ind.		8.50–10.00		10.00[8]			8.50[22]	1.35[16]
Ohio points	11.50	7.50	7.50	12.00	8.00	11.00[23]	7.50	1.50[16]
Scioto, Ohio	11.50	7.50	7.50	8.50	8.25	.62½	7.00	1.50
Sheboygan, Wis.		10.50					9.50	2.00[4]
Wisconsin points[6]		11.50					9.50	
Woodville, Ohio	11.50	7.50	7.50	12.50	8.00	10.00[9]	8.00	1.50[9]
SOUTHERN:								
El Paso, Texas							7.00	1.50
Frederick, Md.		8.00–9.50	8.00–9.50			9.50[15]	7.00[15]	
Graystone & Landmark, Ala.	12.50	9.00		12.50	8.50		7.50	1.35
Keystone, Ala.		9.00	8.00	9.00	9.00	11.00	7.50	1.35
Knoxville, Tenn.	19.00	9.00	9.00	9.00			7.50	1.35
Ocala and Kendrick, Fla.		11.00		12.00				
WESTERN:								
Kirtland, N. M.							10.00	
Los Angeles, Calif.	15.00	14.00	12.00	18.00			13.50	
San Francisco, Calif.	19.00	17.50	13.00	17.50–19.00	14.50	.90[17]	14.50[19]	1.85[17]
Tehachapi, Calif.[18]	10.80		6.75[11]	12.00			10.30	
Seattle, Wash.	19.00	19.00	12.00	19.00	19.00		18.60	2.30

[1] Barrels. [2] Net ton. [3] Wooden, steel 1.70. [4] Steel; in bbl. .95. [5] Dealers' prices, net 30 days less 25c discount per ton on hydrated lime and 5c per bbl. on lump if paid in 10 days. [7] In paper bags, including bags. [8] To 11.00. [9] 80-lb. [10] In bags. [11] Refuse or air slack, 10.00–12.00. [12] To 3.00. [13] Delivered in Southern California. [15] To 8.00. [16] To 1.70. [17] Less credit for return of empties. [18] 90-lb. sacks. [19] To mortar plant and large industrials, 13.00. [22] To 9.00. [23] Per bbl., 2.15. [30] To 16.50.

Miscellaneous Sands

(Continued)

City or shipping point	Roofing sand	Traction
Utica and Ottawa, Ill.	1.00–3.25	.75
Warwick, Ohio		2.00
Zanesville, Ohio		2.50

*Damp.

Talc

Prices given are per ton f.o.b. (in carload lots only), producing plant, or nearest shipping point.

Chatsworth, Ga.:
- Ground talc (20-50 mesh), bags 5.75– 8.50
- Ground talc (150-200 mesh), bags 7.00–15.00
- Pencils and steel crayons, gross .75– 2.50

Chester, Vt.:
- Ground talc (150-200 mesh), paper bags 7.00– 8.00
- Same, including 50-lb. bags 8.00– 9.00

Chicago and Joliet, Ill.:
- Ground (150-200 mesh), bags 30.00

Conowingo, Md.:
- Crude talc, bulk 4.00
- Ground talc (150-200 mesh), in bags 14.00
- Cubes, blanks, per lb. .10

Dalton, Ga.:
- Crude talc (for grinding) 4.00
- Ground talc (150-200 mesh), bags 9.00
- Pencils and steel worker's crayons, per gross 1.00– 2.00

Emeryville, N. Y.:
(Double air floated) including bags:
- 200 mesh 13.75
- 325 mesh 14.75

Hailesboro, N. Y.:
- Ground talc (300-350 mesh) in 200-lb. bags 15.50–20.00

Henry, Va.:
- Crude (mine run) 3.50– 4.00
- Ground talc (150-200 mesh), bags 6.25–10.50

Joliet, Ill.:
Ground talc (200 mesh) in bags:
- California white 30.00
- Southern white 20.00
- Illinois talc 10.00
- Crude talc 3.75

Keeler, Calif.:
- Ground (200-300 mesh), bags 20.00–30.00

Natural Bridge, N. Y.:
- Ground talc (300-325 mesh), bags 12.00–15.00

(a) Bags extra.

Rock Phosphate

Prices given are per ton (2240-lb.) f.o.b. producing plant or nearest shipping point.

Lump Rock

- Columbia, Tenn.—B.P.L. 65-70% 3.50– 4.50
- Gordonsburg, Tenn.—B.P.L. 68-72% 4.00– 4.50
- Mt. Pleasant, Tenn.—B.P.L., 77% 6.50
- Tennessee — F.o.b. mines, gross ton, unground brown rock, B.P.L. 72% 5.00
- B.P.L. 75% 6.00
- Twomey, Tenn.—B.P.L. 65%, 2000 lb. 8.00– 9.00

Ground Rock
(2000 lb.)

- Centerville, Tenn.—B.P.L. 65% 8.00
- Gordonsburg, Tenn.—B.P.L. 68% 3.50
- B.P.L. 72% 4.50
- Mt. Pleasant, Tenn.—Lime phosphate:
- B.P.L., 72.50%, 80% thru 300 mesh 11.70
- B.P.L. 72% 5.50– 6.00
- Twomey, Tenn.—B.P.L. 65% 8.00
- Wales, Tenn.—B.P.L. 65% 11.00

Florida Phosphate

(Raw Land Pebble)
(Per Ton)

Florida—F.o.b. mines, gross ton, 68/66%
- B.P.L., Basis 68% 3.25
- 70% min. B.P.L., Basis 70% 3.75

Mica

Prices given are net, f.o.b. plant or nearest shipping point.

New York City, N. Y.—Per lb.,
- Cut mica (1½x2) 1.60
- Cut mica (8x10) 26.00
- Pringle, S. D.—Mine run, per ton 125.00
- Punch mica, per lb. .06
- Scrap, per ton, carloads 20.00

Rumney Depot, N. H.—Per ton,
- Mine run 300.00
- Clean shop scrap 25.00
- Mine scrap 22.50–24.00
- Roofing mica 37.50
- Punch mica, per lb. .12
- Cut mica—50% from Standard List.

Rock Products

Special Aggregates

Prices are per ton f.o.b. quarry or nearest shipping point.

City or shipping point	Terrazzo	Stucco-chips
Brandon, Vt.—English pink, and American Botticino, coral pink	¶12.50–‖14.50	¶12.50–‖14.50
Brighton, Tenn.—Pink marble chips	§3.00	§3.00
Crown Point, N. Y.—Mica spar		b9.00
Davenport, Ia.—White limestone, in bags	6.00	6.00
Easton, Penn.—Royal green	16.00–18.00a	
Harrisonburg, Va. — Bulk marble (crushed, in bags)	12.50–14.00	12.50–14.00
Ingomar, Ohio — Concrete facings and stucco dash		11.00–18.00
Middlebrook, Mo.—Red		20.00–25.00
Middlebury, Vt. — Middlebury white		†9.00–‖10.00
Middlebury and Brandon, Vt.—Caststone, per ton, including bags		5.50
Phillipsburg, N. J.—Royal green granite		15.00–18.00
Randville, Mich.—Crystalite white marble, bulk	4.00	4.00– 7.00
Stockton, Calif.—"Nat-rock" roofing grits		12.00–20.00
Tuckahoe, N. Y.—Tuckahoe white	8.00	
Warren, N. H.		¶7.90–‖8.95
Wauwatosa, Wis.		20.00–32.00
Wellsville, Colo.—Colorado Travertine Stone	15.00	15.00
Whitestone, Ga.		*10.00

†C.L.; L.C.L. 16.00. ¶C.L. ‖L.C.L. (a) Including bags. (b) In 100-lb. bags, car lots, min. car 20 tons. * Per 100 lb.

Potash Feldspar

Auburn and Topsham, Me.—Color white, 98% thru 140-mesh	19.00
DeKalb Jct., N. Y.—Color, white; analysis, K_2O, 2.11%; Na_2O, 6.86%; SiO_2, 74.04%; Fe_2O_3, .063%; Al_2O_3, 14.59%; pulverized, 100% thru 200 mesh, in bags, per ton, 22.00; bulk	20.00
East Hartford, Conn. — Color, white, 40 mesh to 200 mesh	15.00–28.00
East Liverpool, Ohio — Color, white; 98% thru 200 mesh, bulk	19.35
Soda feldspar, crude, bulk, per ton	22.00
Trenton, N. J.—White; analysis, K_2O, 11%-13%; Na_2O, 1.5%-2.70%; SiO_2, 63%-67.80%; Fe_2O_3, .09%; Al_2O_3, 18.25%-20%; pulverized, 99.5% thru 200 mesh	20.00
Erwin, Tenn., and Spruce Pine, N. C.	16.00
Rochester, N. Y.	22.00
Los Angeles, Calif.—Color, white; analysis, K_2O, 12.16%; Na_2O, 1.53%; SiO_2, 65.60%; Fe_2O_3, .10%; Al_2O_3, 19.20%; Arizona spar, crude, bags, 12.50–14.00; bulk	11.00–12.50
Pulverized, 95% thru 200 mesh; bags, 19.73–23.50; bulk	15.75–22.50
Pulverized, 20% thru 80 mesh; bags, 17.60; bulk	16.50
Murphysboro, Ill.—Color, prime white; analysis, K_2O, 12.60%; Na_2O, 2.35%; SiO_2, 63%; Fe_2O_3, .06%; Al_2O_3, 18.20%; 98% thru 200 mesh; bags, 21.00; bulk	20.00
Penland, N. C.—White; crude, bulk	8.00
Ground, bulk	16.50
Spruce Pine, N. C.—Color, white; analysis, K_2O, 10%; Na_2O, 3%; SiO_2, 68%; Fe_2O_3, 0.10%; Al_2O_3, 18%; 99½% thru 200 mesh; pulverized, bulk, 18.00; crude, bulk (Bags 15c extra.)	10.00
Tennessee Mills—Color, white; analysis, K_2O, 10%; Na_2O_3, 3%; SiO_2, 68%; 99½% thru 200 mesh; bulk (Bags, 15c extra)	18.00
Toronto, Can.—Colo, flesh; analysis K_2O, 12.75%; Na_2O, 1.96%; crude	7.50– 8.00

Chicken Grits

Afton, Mich.—(Limestone), per ton	1.75
Belfast, Me.—(Limestone), per ton	‡10.00
Chico, Tex.—Hen size and Baby Chick, packed in 100-lb. sacks, per sack	1.00
Danbury, Conn.; Adams, Ashley Falls, and West Stockbridge, Mass.—(Limestone)	‡7.50–*9.00
Davenport, Ia.—(Limestone), bags, per ton	6.00
Easton, Penn.—In bags	8.00
El Paso, Tex.—Per ton	1.00
Knoxville, Tenn.—Per bag	1.25
Los Angeles, Calif.—Per ton, including sacks:	
Feldspar	14.00
Gypsum	7.50– 9.50
Marion, Va.—(Limestone), bulk, 5.00; bagged, 6.50; 100-lb. bag	.50
Middlebury, Vt.—Per ton (a)	10.00
Piqua, O. (b)—(Pearl Grit), fine and medium, per ton	¶8.00
Randville, Mich.—(Marble), bulk	6.00
Rocky Point, Va.—(Limestone), 100-lb. bags, 50c; sacks, per ton, 6.00; bulk	5.00
Seattle, Wash.—(Gypsum), bulk, per ton	10.00
Tuckahoe, N. Y.	8.00
Waukesha, Wis.—(Limestone), per ton	7.00
Wisconsin Points—(Limestone), per ton	15.00
Winona, Minn.—(Limestone), sacked, per ton, 8.00; bulk, per ton	6.00

*L.C.L. †Less than 5-ton lots. ‡C.L. ¶100-lb. bags. (a) F.o.b. Middlebury, Vt. (b) F.o.b. Piqua, Ohio.

Sand-Lime Brick

Prices given per 1000 brick f.o.b. plant or nearest shipping point, unless otherwise noted.

Albany, Ga.	11.00
Barton, Wis.	10.50g
Boston, Mass.	17.00*
Brighton, N. Y.	19.75*
Dayton, Ohio	12.50–13.50
Detroit, Mich. (h)	j13.00–16.00*d
Farmington, Conn.	13.00
Flint, Mich.	18.00†
Grand Rapids, Mich.	12.50
Hartford, Conn.	13.00–17.00*
Jackson, Mich.	13.00
Lakeland, Fla.	10.00–11.00
Lake Helen, Fla.	9.00–12.00
Lancaster, N. Y.	12.25
Madison, Wis.	12.50a
Mishawaka, Ind.	11.00
Milwaukee, Wis.	13.00*
Minneapolis, Minn.	10.00
New Brighton, Minn.	12.75
Pontiac, Mich.	12.50
Portage, Wis.	15.00
Prairie du Chien, Wis.	18.00–22.50
Rochester, N. Y.	19.75
Saginaw, Mich.	13.50
San Antonio, Texas	12.50
Sebewaing, Mich.	12.50
Sioux Falls, S. Dak.	13.00
South River, N. J.	13.00
South St. Paul, Minn.	9.00
Syracuse, N. Y.	18.00–20.00
Toronto, Canada (f)	15.00†e
Wilkinson, Fla.	12.00–16.00
Winnipeg, Canada	15.00

*Delivered on job. †5% disc. 10 days. ‖Dealers' price. (a) Less 50c disc. per M, 10th of month. (d) 5% disc., 10th of month. (e) Delivered. (f) In yard, 12.50. (g) Delivered Milwaukee, 13.00. (h) Also 15.50. (j) Also 14.00.

Portland Cement

	Per Bag	Per Bbl.	High Early Strength
Atlanta, Ga.		2.36	3.51¶
Baltimore, Md.		2.25–2.65	3.55¶
Birmingham, Ala.		2.00	3.44¶
Boston, Mass. (g)	.68¾	2.23–2.73e	3.27¶
Buffalo, N. Y.	.62½	2.10†	3.40¶
Butte, Mont.	.90¾	3.61	
Cedar Rapids, Iowa		2.24	
Charleston, S. C.		2.25–2.65d	3.58¶
Cheyenne, Wyo.	.64	2.56	
Chicago, Ill.		2.05–2.45	3.35¶
Cincinnati, Ohio		2.22–2.62	3.52¶
Cleveland, Ohio		2.24–2.64	3.54¶
Columbus, Ohio		2.22–2.62	3.52¶
Dallas, Texas		1.80	3.39¶
Davenport, Iowa		2.24	
Dayton, Ohio		2.22–2.64	3.54¶
Denver, Colo.	.63¾	2.55	
Des Moines, Iowa		2.14	
Detroit, Mich.		1.95–2.35	3.27¶
Duluth, Minn.		2.04	
Houston, Texas		1.90	3.63¶
Indianapolis, Ind.	.54¾	2.09–2.49	3.39¶
Jackson, Miss.		2.04–2.44	3.53¶
Jacksonville, Fla.		2.60b	3.79¶
Jersey City, N. J.		2.13–2.53	3.43¶
Kansas City, Mo.	.45½	1.82	3.22¶
Los Angeles, Calif.	.55	2.20	
Louisville, Ky.	.55½	2.57	3.47¶
Memphis, Tenn.		2.04–2.44	3.34¶
Milwaukee, Wis.		2.20–2.60	3.50¶
Minneapolis, Minn.		2.12–2.32	
Montreal, Que.		1.60	
New Orleans, La.	.45½	1.82	3.72¶
New York, N. Y.	.60¾	1.93–2.43	3.33¶
Norfolk, Va.		1.97	3.27¶
Oklahoma City, Okla.	.57¼	2.29	3.69¶
Omaha, Neb.	.54	2.16	3.56¶
Peoria, Ill.		2.22	
Pittsburgh, Penn.		2.05–2.44	3.35¶
Phoenix, Ariz.		3.91*	
Portland, Ore.‡		2.40–2.90a	
Reno, Nev.‡		2.91–3.41a	
Richmond, Va.		2.32–2.72	3.62¶
Salt Lake City, Utah	.70¾	2.81	
San Francisco, Calif.‡		2.21–2.71a	
Savannah, Ga.		2.60c	3.65¶
St. Louis, Mo.	.48¾	1.95–2.35	f3.25¶
St. Paul, Minn.		2.12–2.22	
Seattle, Wash.		†2.50–2.65j	f3.50†
Tampa, Fla.		2.40	4.08¶
Toledo, Ohio		2.20–2.60	3.50¶
Topeka, Kans.	.50¼	2.01	3.41¶
Tulsa, Okla.	.53¼	2.13	3.53¶
Wheeling, W. Va.		2.12–2.52	3.42¶
Winston-Salem, N. C.		2.29–2.69	3.59¶

Mill prices f.o.b. in carload lots, without bags, to contractors.

Albany, N. Y.	.43¾	1.75	
Bellingham, Wash.		2.10	
Buffington, Ind.		1.80	
Chattanooga, Tenn.		2.45*	
Concrete, Wash.		2.35	
Davenport, Calif.		2.05	
Hannibal, Mo.		1.90	
Hudson, N. Y.		1.75	
Leeds, Ala.		1.65	
Lime and Oswego, Ore.		2.50‡	
Mildred, Kan.		2.35	
Nazareth, Penn.		2.15	
Northampton, Penn.		1.75	
Richard City, Tenn.		2.05	
Steelton, Minn.		1.85	
Toledo, Ohio		2.20	
Universal, Penn.		1.80	

NOTE—Add 40c per bbl. for bags. *Includes sacks. †10c disc., 10 days. ‡10c disc., 15 days. (a) Includes cloth sacks returnable at 10c each. (b) 24c bbl. refund for paid freight bill. (c) 35c bbl. refund for paid freight bill. (d) 40c bbl. refund for paid freight bill. (e) 45c bbl. foreign refund. (f) "Velo" cement, including cost of paper bag. ¶ "Incor" Perfected prices per bbl. packed in paper sacks, subject to 10c disc. 15 days. (g) Also 2.33 per bbl. (j) 25c bbl. disc. 10 days.

Gypsum Products— CARLOAD PRICES PER TON AND PER M SQUARE FEET, F.O.B. MILL

	Crushed Rock	Ground Gypsum	Agricultural Gypsum	Stucco Calcined Gypsum	Cement and Gaging Plaster	Wood Fiber	Gaging White	Plaster Sanded	Cement Keene's	Finish Trowel	—Plaster Board— ¼x32x 36". Per M Sq. Ft.	¼x32x 36". Per M Sq. Ft.	Wallboard, ¼x32 or 48" Lengths 6'-10'. Per M Sq. Ft.
Acme, Tex.	1.50–3.00	4.00	4.00	4.00–6.00	4.00–6.00	4.00–6.00	10.00	10.00	19.00	19.00	10.50	10.50	12.00
Blue Rapids, Kan.	1.50–3.00	4.00	4.00	4.00–6.00	4.00–6.00	4.00–6.00	10.00	10.00	19.00	19.00	10.50	10.50	12.00
Des Moines, Iowa	3.00	8.00	9.00	10.00	10.00	10.50	13.50	12.00	24.00	22.00	18.00	21.00	30.00
Detroit, Mich.					14.30o	12.30m		m9.00–11.00o					25.00
Delawanna, N. J.				4.50–5.00	13.10–14.00	5.00		7.25					
East St. Louis, Ill.	Special Gypsum Products—Interior partition section, 4 in. wide, 12 in. thick and up to 10 ft. 6 in. long, per ton, 21.00; 6x6 in. and up to 10 ft. 6 in. long, per ton, 30.00; floor section, 7x16 in. and up to 13 ft. 6 in. long, per ton, 23.00.												
Ft. Dodge, Iowa; N. Holston, Va.; Akron, N. Y.	1.50–3.00	4.00	4.00	4.00–6.00	4.00–6.00	4.00–6.00	10.00	10.00	19.00	19.00	10.50	10.50	12.00
Grand Rapids, Mich.	1.50–3.00	4.00	4.00	4.00–6.00	4.00–6.00	4.00–6.00	10.00	10.00	19.00	19.00	10.50	10.50	12.00
Gypsum, Ohio	1.70–3.00	4.00	6.00	7.00–9.00	9.00	9.00	19.00	7.00	24.50	19.00		15.00	20.00–25.00
Los Angeles, Calif. (f)		7.50–9.50	7.50–9.50	8.50–10.00	9.00–11.00		9.00–11.00		29.00–34.00				
Medicine Lodge, Kan.									15.00				
Oakfield, N. Y.	2.50			5.50	6.00	6.00		5.50				15.00	25.00
Port Clinton, Ohio	3.00	4.00	6.00	10.00	9.00	9.00	21.00	7.00	30.15	20.00		20.00	30.00
Portland, Colo.				10.00									
Providence, R. I.				13.00							Partition block, solid reinforced, 12x30x3", 7c per sq. ft. in truck lots		
San Francisco, Calif.			9.00	13.40	14.40		15.40						
Seattle, Wash.		10.00m	10.00m	13.00m			14.00		23.00				
Winnipeg, Man.	5.00	4.90	7.00	13.00	14.00	14.00					20.00w		33.00

NOTE—Returnable bags. 10c each; paper bags, 1.00 per ton extra (not returnable. (a) Hardwall plaster, 13.00; casting, finishing molding, 14.00; (b) Calacoustic plaster, 10.00 at mill; (c) Plaster lath; (d) ¼x48x36 in.; (f) plasterboard, 18c to 20c per yd.; (m) includes paper bags; (o) includes jute sacks; (u) includes sacks; (v) retail, 35.00; (w) 16x48-in.

Market Prices of Cement Products and Slate

Concrete Block

Prices given are net per unit, f.o.b. plant or nearest shipping point.

City or shipping point	Size 8x8x16
Camden, N. J.	17.00
Cement City, Mich.	55.00¶
Chicago District‖	180.00–210.00a
8x10x16	230.00–260.00a
8x12x16	280.00–330.00a
Columbus, Ohio	13.00
Detroit, Mich. (d)	.15– .17†
Forest Park, Ill.	21.00*
Grand Rapids, Mich.	11.00*
Graettinger, Iowa	.18– .20
Indianapolis, Ind.	.10– .12a
Los Angeles, Calif.	4x8x12–5.00*
Olivia and Mankato, Minn.	9.50b
Somerset, Penn.	.18– .20
Tiskilwa, Ill.	.16– .18†
Yakima, Wash.	20.00*

*Price per 100 at plant. †Rock or panel face. ‡Delivered. ¶5x8x12, 55.00 per 1000. (a) Face. (b) Per ton. (c) Plain. (d) 8x12x16, rock or panel face, .24–.26.

Cement Building Tile

Cement City, Mich.:	
5x8x12, per 100	5.00
Chicago District (Haydite):	
4x 8x16, per 100	14.00
8x 8x16, per 100	20.00
8x12x16, per 100	28.00
Columbus, Ohio:	
5x8x12, per 100	6.50
Detroit, Mich.:	
5½x8x12, per M	75.00
Grand Rapids, Mich.:	
5x8x12, per 100	6.00
Longview, Wash.:	
4x6x12, per 100	5.00
4x8x12, per 100	6.25
Mt. Pleasant, N. Y.:	
5x8x12, per M	78.00
Houston, Texas:	
5x8x12 (Lightweight), per M	80.00

Cement Roofing Tile

Prices are net per square, carload lots, f.o.b. nearest shipping point, unless otherwise stated.

Camden and Trenton, N. J.—8x12, per sq.:	
Red	15.00
Green	18.00
Cicero, Ill.—French and Spanish, 8x15, per sq., red, 11.50; green	13.50
English 7½x15½ per sq., red 18.00; green	20.00
Detroit, Mich.—5x8x12, per M	67.50
Houston, Texas—Roofing Tile, per sq.	25.00
Indianapolis, Ind.—9x15-in.	Per sq.
Gray	10.00
Red	11.00
Green	13.00
Waco, Texas:	Per sq.
4x4	60
Pasadena, Calif. (Stone Tile):	
3½x4x12, per 100	3.00
3½x6x12, per 100	4.00
3½x8x12, per 100	5.50
Tiskilwa, Ill.;	
8x8, per 100	15.00
Wildasin Spur, Los Angeles, Calif. (Stone-Tile):	
3½x6x12, per M	50.00
3½x8x12, per M	60.00
Prairie du Chien, Wis.:	
5x8x12, per M	82.00
5x4x12, per M	46.00
5x8x6 (half-tile), per M	41.00
5x8x10 (fractional), per M	82.00
Yakima, Wash. (Building Tile):	Each
5x8x12	.10

Concrete Brick

Prices given per 1000 brick, f.o.b. plant or nearest shipping point.

	Common	Face
Appleton, Minn.	22.00	25.00– 40.00
Baltimore, Md. (Del. according to quantity)	15.50	22.00– 50.00
Camden & Trenton, N. J.	17.00	.....
Chicago District "Haydite"	14.00	.....
Columbus, Ohio	16.00	17.00
El Paso, Tex.—Klinker	10.00	.....
Ensley, Ala. ("Slagtex")	12.50	.....
Eugene, Ore.	25.00	35.00– 75.00
Forest Park, Ill.	.....	37.00
Friesland, Wis.	22.00	32.00
Longview, Wash.*	15.00	22.50– 65.00
Los Angeles, Calif.	12.50	.....
Milwaukee, Wis.	14.00	30.00
Mt. Pleasant, N. Y.	.....	14.00– 23.00
Omaha, Neb.	18.00	30.00– 40.00
Pasadena, Calif.	10.00	.....
Philadelphia, Penn.	15.50	17.50
Portland, Ore.	17.50	23.00– 55.00
Mantel brick—100.00–150.00		
Prairie du Chien, Wis.	14.00	22.00– 25.00
Rapid City, S. D.	18.00	30.00– 40.00
Waco, Texas	16.50	32.50–125.00
Watertown, N. Y.	20.00	35.00
Westmoreland Wharves, Penn.	14.75	20.00
Winnipeg, Man.	14.00	22.00
Yakima, Wash.	22.50	.....

*40% off List.

Wholesale Prices of Slate

Prices given are f.o.b. at producing point or nearest shipping point

Slate Flour

Pen Argyl, Penn.—Screened 200 mesh, $7.00 per ton in paper bags.

Slate Granules

Esmont, Va.—Blue, $7.50 per ton.
Granville, N. Y.—Red, green and black, $7.50 per ton.
Pen Argyl, Penn.—Blue-black, bulk, $6.00 per ton.

Roofing Slate

Prices per square—Standard thickness.

City or shipping point:	3/16-in.	¼-in.	⅜-in.	½-in.	¾-in.	1-in.
Arvonia, Va.—Oxford gray Buckingham	14.62	18.13	23.40	26.33	32.14	40.95
Bangor, Penn.—No. 1 clear	10.50–14.50	24.50	29.00	33.50	44.50	55.60
No. 1 ribbon	9.00–10.25	20.00	24.50	29.00	40.00	51.25
Gen. mediums	9.50–11.25	.....	.....	.....	.....	.....
No. 2 ribbon	6.75– 7.25	.....	.....	.....	.....	.....
No. 1 Albion clear	7.25–10.50	16.00	23.00	27.00	37.00	46.00
Albion mediums	8.00– 9.00	.....	.....	.....	.....	.....
Chapman Quarries, Penn.—No. 1	8.50–11.25	.....	.....	.....	.....	.....
Medium	7.75– 9.00	.....	.....	.....	.....	.....
Hard vein	.....	16.00	23.00	26.00	32.00	40.00
Granville, N. Y.—Sea green, weathering	14.00	24.00	30.00	36.00	48.00	60.00
Semi-weathering, green and gray	15.40	24.00	30.00	36.00	48.00	60.00
Mottled purple and unfading green	21.00	24.00	30.00	36.00	48.00	60.00
Red	27.50	33.50	40.00	47.50	62.50	77.50
Monson, Maine	19.80	24.00	.....	.....	.....	.....
Pen Argyl, Penn.*						
Graduated slate (blue)	.....	16.00	23.00	27.00	37.00	46.00
Graduated slate (grey)	.....	18.00	25.00	29.00	39.00	48.00
Color-tone	11.50–12.50; Vari-tone, 12.00–13.00; Cathedral gray, 14.00–15.00					
No. 1 clear (smooth text)	7.25–10.50; No. 1 clear (rough text), 8.25–9.50					
Albion-Bangor medium	8.00–9.00; No. 2 clear, 8.00–9.00; No. 1 ribbon, 8.00–8.50					
Slatedale and Slatington, Penn.—						
Genuine Franklin	11.25	22.00	26.00	30.00	40.00	50.00
Blue Mountain No. 1	10.50	22.00	26.00	30.00	40.00	50.00
Blue Mountain No. 1 clear	9.50	18.00	22.00	26.00	36.00	46.00
Blue Mountain No. 2 clear	8.00	18.00	22.00	26.00	36.00	46.00

(a) Prices are for standard preferred sizes (standard 3/16-in. slates), smaller sizes sell for lower prices.
(b) Prices other than 3/16-in. thickness include nail holes.
(c) Prices for punching nail holes, in standard thickness slates, vary from 50c to $1.25 per square.
*10% discount to roofer; 10%–8⅓% to wholesaler.

Stone-Tile Hollow Brick

Prices are net per thousand f.o.b. plant.

	No. 4	No. 6	No. 8
Albany, N. Y.*	40.00	60.00	80.00
Asheville, N. C.	35.00	50.00	60.00
Atlanta, Ga.	26.50	45.00	53.00
Brownsville, Tex.*	37.50	50.00	65.00
Brunswick, Me.	35.00	45.00	60.00
Charlotte, N. C.	35.00	45.00	60.00
Farmingdale, N. Y.	37.50	50.00	60.00
Houston, Tex.	35.00	45.00	60.00
Mattituck, N. Y.	45.00	55.00	65.00
Nashville, Tenn.	30.00	49.00	57.00
New Orleans, La.	35.00	45.00	60.00
Norfolk, Va.	35.00	50.00	65.00
Passaic, N. J.	35.00	52.50	70.00
Pawtucket, R. I.	40.00	50.00	70.00
Salem, Mass.	45.00	55.00	75.00

Prices are for standard sizes—No. 4, size 3½x4x12 in.; No. 6, size 3½x6x12 in.; No. 8, size 3½x8x12 in. *Delivered on job.

Cement Drain Tile

Graettinger, Iowa.—Drain tile, per foot: 5-in., .04½; 6-in., .05½; 8-in., .09; 10-in., .12½; 12-in., .17½; 15-in., .35; 18-in., .50; 20-in., .60; 24-in., 1.00; 30-in., 1.35; 36-in.	2.00
Longview, Wash.—Drain tile, per foot: 3-in., .05; 4-in., .06; 6-in., .10; 8-in., .15; 10-in.	.20
Olivia and Mankato, Minn.—Cement drain tile, per ton	8.00
Tacoma, Wash.—Drain tile, per 100 ft.	
3-in.	4.00
4-in.	5.00
6-in.	7.50
8-in.	10.00
Waukesha, Wis.—Drain tile, per ton	8.00

Current Prices Cement Pipe

Prices are net per foot f.o.b. cities or nearest shipping point in carload lots unless otherwise noted

Culvert and Sewer	4 in.	6 in.	8-in.	10 in.	12 in.	15-in.	18 in.	20 in.	22 in.	24 in.	27 in.	30 in.	36 in.	42 in.	48 in.	54 in.	60 in.
Detroit, Mich. (c)																	
Sewer	.10	.12	.22	.30	.40	.60	.90	1.20	.....	1.75	2.00	2.50	3.30	4.50	5.75	6.50	8.00
Culvert	.....	.....	.....	.....	.95	1.25	1.60	.....	.....	2.25	2.50	3.00	3.50	5.00	6.50	8.00	10.00
Grand Rapids, Mich. (b)	.....	.....	.....	.60	.70	.90	1.20	.....	.....	1.80	2.10	2.35	3.50	4.00	5.60	6.90	7.85
Houston, Texas	.....	.19	.28	.43	.55½	.90	1.30	.....	1.70†	2.20	.....	.....	.....	.....	.....	.....	.....
Indianapolis, Ind. (a)	.....	.....	.....	.75	.85	.90	1.15	.....	.....	1.60	.....	2.50	.....	.....	.....	.....	.....
Mankato, Minn. (b)	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.50	1.75	2.50	3.25	4.25	.....	.....	.....
Newark, N. J.							6 in. to 24 in., 12.00 per ton										
Norfolk, Neb. (b)	.....	.....	.....	.90	1.00	1.13	1.42	.....	.....	2.11	.....	2.75	3.58	.....	6.14	.....	7.78
Paulina, Iowa‡	.....	.....	.....	.....	.....	.....	.....	2.25	.....	2.11	.....	2.75	3.58	.....	6.14	.....	7.78
Somerset, Penn.	.....	.....	.....	.....	1.08	1.25	1.65	.....	.....	2.50	.....	3.65	4.85	7.50	8.50	.....	.....
Tiskilwa, Ill. (rein.)	.....	.....	.....	.75	.85	.95	.70	1.55	.....	.....	.....	.....	.....	.....	.....	.....	.....
Tacoma, Wash.	.15	.17	.22	.30	.40	.55	75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wahoo, Neb. (b)	.....	.....	.....	.....	.85½	.....	114	.....	.....	1.81	.....	2.47	3.42	4.13	5.63	6.49	7.31
Yakima, Wash.	.....	.....	.....	.....	.....	.....	1.42	.....	.....	2.11	.....	2.75	3.58	4.62	6.14	6.96	7.78

(a) 24-in. lengths. (b) Reinforced (c) Delivered on job; 5% discount, 10th of month. †21-in. diameter. ‡Price per 2-ft. length.

James W. Fuller

A BRIEF NOTICE of the death in San Francisco, Calif., on April 4, of Col. James W. Fuller, president of the Fuller Co., Catasauqua, Penn., president of the Allentown Portland Cement Co., president of the Valley Forge Cement Co., appeared in ROCK PRODUCTS, April 13, p. 123. Since then the editor has acquired biographical material for a more adequate appreciation of this dynamic and well-beloved character, who leaves such a lasting imprint in the portland cement industry, not only of this country, but of the entire world.

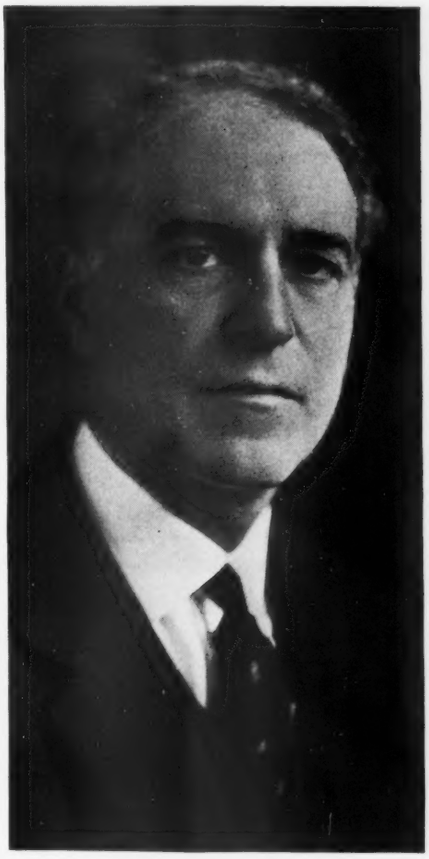
James W. Fuller was born April 2, 1873, at Catasauqua, Penn. He was a son of James W. Fuller, who was a successful man of affairs, president of the McKee Fuller Co., which was subsequently the Lehigh Car Wheel and Axle Co., and later on the Fuller-Lehigh Co. of which he was the founder and executive head up to the time of his death, after which he was succeeded by his son James W. Fuller, the subject of this sketch.

James W. Fuller was educated at the famous Haverford Preparatory School, at Haverford, Penn., and after completing his schooling his first occupation was with the McKee Fuller Co. where he apprenticed himself to the moulders and machinists trade. After mastering the details of his vocation he continued his career with the corporation working through the different departments in various capacities and upon the death of his father he was elected president of the Fuller-Lehigh Co., which position he ably filled until January 4, 1926, when the company was sold to the Babcock and Wilcox Co. and he remained with them as chairman of the board until April 1, 1926, when he retired and organized the Fuller Co., of which he was president, with executive headquarters at Catasauqua, Penn. This corporation was formed for the purpose of handling the Fuller-Kinyon system for materials other than pulverized fuel, which part of the business was not included in the sale to the Babcock and Wilcox Co., and the Fuller Co. handles all business in connection with the conveying of materials other than pulverized fuel.

During the World War the Fuller-Lehigh Co. did 100% war work for the United States government, making pulverized-coal machinery for boilers, locomotives and all kinds of metallurgical furnaces. Mr. Fuller was the pioneer in the pulverized fuel field. If the war had lasted much longer there would have been a serious shortage of fuel oil. Pulverized coal was used successfully on the United States Ship *Gem* during the war.

Quotations from an appreciation of Colonel Fuller, from his hometown newspaper, the *Catasauqua Dispatch,* follow:

"A man of varied interests, strong personality and keen insight, Colonel Fuller was at once a commanding figure in the industrial world. Big business was but as a game in his life, and according to its rules, he played it. In addition to his connections with the Fuller Co., he was president of the Allentown Portland Cement Co. and of the Valley Forge Cement Co., and a director of the Wahnetah Silk Co., the Lehigh County Agricultural Society and McDermott Brothers, and a trustee of the board of directors of the Haverford School. Prior to their sale, he was also a director of the



Col. James W. Fuller

Railway Steel Spring Co. and a member of the executive committee of the Empire Steel and Iron Co. His professional connections included the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, the International Railway Fuel Association, the American Iron and Steel Institute and the Pennsylvania State Chamber of Commerce.

"Colonel Fuller was a direct descendent of Edward Fuller, one of the signers of a compact drawn up by the Pilgrim fathers aboard the *Mayflower* prior to their landing at Plymouth in November, 1620. These ancestors emigrated to Pennsylvania after a short stay in the New England territory, and located in eastern Pennsylvania, some in the coal regions, and others in and around Lehigh county. Descendent of Republican ancestry, it was but natural that Colonel Fuller should have embraced the political faith of his forebears. He served on the military staff of Governor John K. Tenor, holding the rank of Colonel.

"Socially, Colonel Fuller was a member of many prominent and influential clubs. He was an ardent devotee of out-door sports, a superb horseman, and a tennis and golf player of unusual caliber. His beautiful estate, the Willow Brook Farms, was the scene of many notable tournaments, many of the contestants having world-wide reputations in the realm of sport. His clubs included the Manufacturers' Club of Philadelphia, the Livingston Club of Allentown, the Germantown Cricket Club, the Saucon Valley Country Club, the Westchester-Biltmore Club of Rye, N. Y., the Engineers' Club of New York, the Racquet Club of Philadelphia, the Northampton and Lehigh Country Clubs and the Congressional Country Club of Washington, D. C.

"Aside from the pleasure he derived from his business enterprises, Colonel Fuller found his greatest enjoyment among the hills and vales of his magnificent Willow Brook estate. Here, amid beautiful natural surroundings, were bred superb animals, Belgians, Percherons, and saddle horses, the winners of many blue ribbons for their fondly proud owner. The registered Guernsey herd of the Willow Brook Farms is one of the most famous in America. Smaller farm animals of the highest type and farm products likewise won their share of efficient attention. Colonel Fuller had a passion for all animal life, and no creature was too lowly to gain his friendly notice.

"Blessed always with the advantages born of wealth and influence, Colonel Fuller never permitted himself the isolation so frequently surrounding men of affairs. A worthy interviewer never found himself outside the bolted door. Many were his benefactions, lacking only in publicity. His unofficial payroll, known only to the recipients of his pension system, mark the glowing generosity with which he was endowed.

"Colonel Fuller is survived by his wife, Dorothy, (Stahlkop) Fuller, and by three children, James W. Fuller, 4th, Charlton Thomas Fuller, and Emily Fuller. There survive, also, three sisters, Mrs. Maude M. Elverson of Catasauqua, and Mrs. Mary L. McCaskey and Mrs. L. A. Salade of Medford, Ore.

France Stone Co. Purchases Bascom Quarries Co.

PROPERTIES of the Bascom Quarries Co. at Bascom, Ohio, west of Tiffin, were sold on February 19th to the France Stone Co., of Toledo, Ohio. The France company had previously held an interest in the Bascom company. The sale gives the France company control of virtually all the stone quarries in Seneca county—*Cleveland* (Ohio) *Plain Dealer.*

New Machinery and Equipment

Batching plant suitable for use in central mixing plants

New Type of Portable Concrete Batching Plant

THE Erie Steel Construction Co., of Erie, Penn., has brought out a new bin, known as the "Type G-Portable," which is designed especially for its platform-operated "AggreMeters." The bin bottom of this new unit is off-center, which allows more floor area and shelter for the operator. The company also claims that it is not possible for the aggregates to arch in a bin of this type because the sides are almost perpendicular.

While the "Type G." aggremeter plant is specially suited for road work and general contracting, it is also readily adaptable to use at central mixing plants for loading directly to the mixer hopper. Because the bottom of the bin is off-center, the mixer can either be set under the bin or in front of it to meet the needs of varying conditions.

The capacities of this type of bin are claimed to be much larger than any other similar portable unit. It is built in capacities of 60, 73, 74, and 91 tons. The 60 and 74 ton sizes are shipped in two pieces with the aggremeter attached, so that it is only necessary to put the two sections together. On these two sizes the top section is flared at the ends only.

The 73 and 91 ton sizes come in two main sections with an additional top section. These units have a top flared on all four sides, which is assembled on the ground and then attached to the top section. The bottom section also has the aggremeter attached. Since the sections are interchangeable, the customer can purchase a 60-ton unit and at a later date make it into a larger unit by simply adding a 73, 74, or 91 ton top section. The frame for the 60-ton bin is standard, and is stated to be of ample strength for all sizes of "Type G." bins.

The total weight of the new style bin is so divided that an ordinary crane can handle the sections with ease, the announcement states. The sections can be moved from place to place on a trailer or flat car, and it requires but a short time to assemble the two sections together, the company states. Then the plant is ready for operation.

A New Three-and-a-half Ton Hoist

A NEW hoist, the WH, has just been designed for various uses by the Novo Engine Co., Lansing, Mich., for handling loads up to 3½ tons. The standard line speed is 250 ft. per min., the greater loads, of course, being handled at lower speeds. A special high speed one-drum hoist is included in the series that has a line speed of 480 and 520 ft. per min. and a load capacity of 1500, 2300 and 2700 lb. The regular hoists are manufactured in one, two and three drum units.

Strength and rigidity has been achieved by constructing the frames, gears, ratchets and pawls of Novite. Novite is the new alloy perfected by the Novo Engine Co. that has a transverse strength of 80% to 100% more than cast iron, it is claimed. It is also claimed to wear four to six times as long as the best grade of semi-steel.

Danger of the base warping and the gears and bearings consequently twisting from line is eliminated by using the Novo all-welded steel base. Electric welding of each joint unites the base parts into a rigid one-piece unit. To further insure absolute rigidity, spreaders are tubular rather than the usual square castings or channels. By actual test at the Michigan State College, East Lansing, Mich., it was found that a 2½-in. pipe resisted 10 times more tortional force than a 4-in. steel channel —although the channel weighed slightly more per foot than the pipe which was tested.

Half-Size Hydrator for Lime Plants of Small Capacities

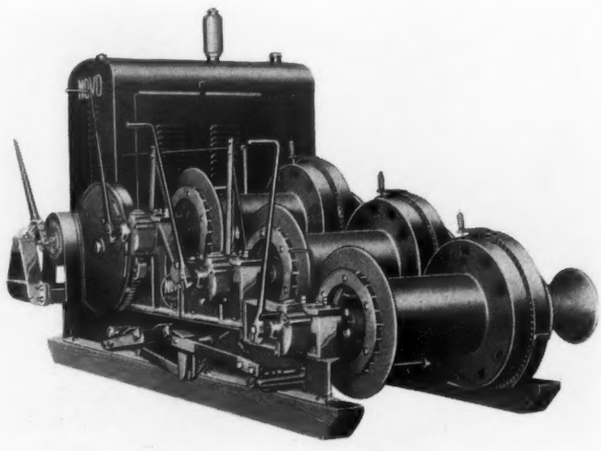
ARNOLD AND WEIGEL, Woodville, Ohio, has announced a half-ton-batch type lime hydrator, known as the "Weber, Jr." The design and manufacture of this machine was the result of a demand by producers who required only a small tonnage of hydrated lime and where initial investments did not require major equipment or the large capacities obtained with the present standard sizes of this firm's Weber hydrators.

The company states that the "Weber, Jr.," embraces all the sturdy and rigid construction features of the large "Weber" hydrator. It is simple and compact, assures uniform quality and thorough mix, is easily accessible and is automatic when once the proper proportion of lime and water is determined, according to the manufacturers. Its simplicity, strength and durability eliminates the possibility of quick wearing and reduces the cost for upkeep and repairs to a minimum, it is claimed.

The capacity of the "Weber, Jr.," is rated at 2 tons of hydrated lime per hour, or four ½-ton batches. It is electrically driven through a speed reducer direct-connected to the main shaft of the hydrator, the same as in the larger sizes.

To Handle Business Direct

THE DOBBIE FOUNDRY AND MACHINE CO., Niagara Falls, N. Y., which has been selling its line of hoisting machinery, derricks, derrick fittings, etc., through the Munday Sales Corp., New York City, announces that it will now sell direct from its factory at Niagara Falls.



New hoist for handling loads up to 3-1/2 tons

New rehandling bucket

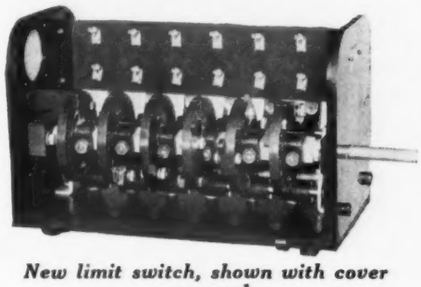
Two Types of Improved Buckets

THE OWEN BUCKET COMPANY, Cleveland, Ohio, has recently introduced two new and improved types clamshell buckets, one a rehandling bucket of exceptionally large capacity for its size, and the other an unusually strong, heavy duty, digging bucket. The former, designated as "Type S," has been designed for maximum output when rehandling loose or compact materials. It is constructed on liberal lines, the manufacturers state, and due to its exceptional width and length when opened, it is particularly efficient for cleaning up materials loaded to shallow depths distributed over large areas. It is recommended for unloading barges, flats, cars and for stock pile work.

The Type "S" bucket is made in standard, heavy and special models to suit requirements. Some of its important exclusive features include: one-piece steel crosshead; concentration of weight located on the centershaft which affords greater digging power; sealed centershaft bearings, keeping the grease in and the grit out, an advantage essential to low upkeep and operating costs; rigid shell construction with minimum number of parts; proper reinforcement; and long life for sheaves and cables due to the exclusive method of mounting on the main counterweight.

Improved type of digging bucket

The digging bucket is designated as "Type O." It is designed for extra heavy digging and handling or for any work that subjects the bucket to excessive and severe strains, and it is of exceptionally strong construction throughout. Some of the exclusive features incorporated in these buckets are: one-piece extra heavy renewable jaws, grit-proof lubricated bearings, concentration of weight low in the construction for greater digging power, and the Owen method of stopping the jaws at a fixed open position to absorb dropping shocks. These buckets are made in standard, extra heavy and narrow models to suit every difficult digging problem. They are particularly efficient and durable for work in stiff clay, ore, broken rock, slag or shale, dredging coarse gravel or other materials that demand a bucket of unusual stength and wear-resistant qualities, accordcording to the manufacturer.



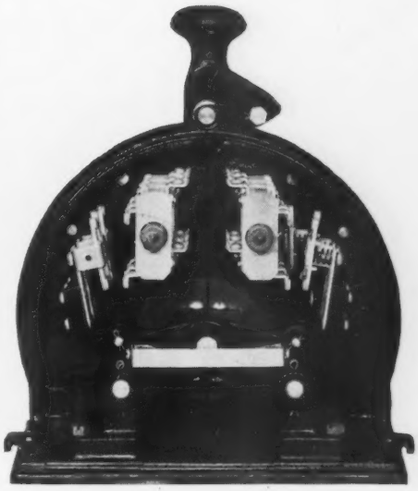
New limit switch, shown with cover removed

New Switches Have Wide Range of Applications

A NEW LINE of cam-operated, double-break master and limit switches is announced by the General Electric Co. of Schenectady, N. Y. The limit switches bear the designation LS-429 and are expected to be of especial value on such applications as skip hoists, car dumpers and other machines requiring geared type switches. The new master switches bear the designations C-3614 and C-3616, and are in general for the same type of service as the limit switches.

The limit switches can be adjusted by shifting, tripping and closing dogs on the cams. The contact mechanism is of the snap-action type and is latched in both the open and closed positions. This gives a positive action to the switch and also allows adjustment of the operating dogs to operate the contact mechanism through the entire 360 deg. of rotation.

The master switches are available in three forms. The one-point switch bears the designation C-3614-AA; the three-point switch is designated C-3614-BA, and the four-point device is known as the C-3616-AA.



Three-point, reversing master switch with cam-operated double-break silver contacts

The manufacturer gives the following as the outstanding features of the new line: Double-break, silver-faced contacts; no shunts to break and burn off; freedom of contact parts from dust and other accumulations; molded insulation on cams and contact arms; accessibility of molded terminal board for wiring; tips easily renewed and common to all devices in the line; and small overall size and compact design.

Locomotive Manufacturers' Alliance

AN announcement of importance to users of internal combustion locomotives was made recently when details of an alliance between the Baldwin Locomotive Works of Philadelphia and the George D. Whitcomb Co. of Rochelle, Ill., were made public. The Baldwin Locomotive Works, which has obtained a substantial interest in the Whitcomb company, has made arrangements to sell the latter's products in practically all foreign countries through the present Baldwin representatives, and has also reached an agreement whereby it will handle the railway field in the United States for the Whitcomb company.

The combination of these two manufacturers places them in a position to build every size of steam, gasoline, alcohol, distillate, gas-electric or Diesel-electric locomotive, the notice states.

Equipment Manufacturer Changes Organization

IN THE RECENT reorganization of the McLanahan-Stone Machine Co. of Hollidaysburg, Penn., the following officers were elected: Alexander H. McLanahan, president; A. T. Stone, Jr., vice-president; Webster Calvin, treasurer; Ashton Gardner, secretary; Edward Krider, manager; and Wm. F. Kik, consulting engineer.

St. Louis Quarrymen Hear A. T. Goldbeck

ONE of the best recent association meetings in the crushed stone industry was held on April 19 by the St. Louis Quarrymen's Association. Dinner was served at the Jefferson hotel, St. Louis, and there was a good gathering on hand to listen to A. T. Goldbeck, director of the bureau of engineering of the National Crushed Stone Association. Among the guests were a number of engineers and other representatives of the Illinois and Missouri highway departments and of nearby cities.

After the dinner, the meeting was opened by President Wm. Eyerman in a short talk in which he expressed his appreciation of having Mr. Goldbeck present and also of having a good representation of the road engineers on hand. E. J. Krause of the Columbia Quarries Co. followed Mr. Eyerman on the program. Mr. Krause had just returned from Washington, D. C., where he had attended a meeting of the executive committee of the national association. He is a member of the committee and a former president of the association.

Col. E. J. McMahon, executive secretary of the St. Louis association, spoke briefly of the activities of the local group and completed his talk with an introduction of Mr. Goldbeck.

In giving a brief review of the work of the National Crushed Stone Association in its testing of aggregates, Mr. Goldbeck opened his talk with a resumé of the reasons for such investigations. He pointed out that engineers are requiring a higher character of product and one which has a greater uniformity. In the discussion Mr. Goldbeck limited himself to highway work, as the majority of producers present were in this field, and by so doing he could cover the ground much more thoroughly. He aided in putting points across by the use of a number of charts.

The Bureau of Public Roads had put forth a number of requirements for highway construction which Mr. Goldbeck outlined briefly. The first was the abandonment of volumetric proportioning and the adoption of proportion by weight. As an alternate, but not a recommended method, inundation would be allowed. The second requirement was that the lowest water-cement ratio be used that would give a workable mix, or in other words, that the concrete be as dry as possible. The third requirement was that scientific proportioning be used to produce the maximum density. To meet this requirement, three sizes of crushed stone were recommended, ¼ in. to ¾ in., ¾ in. to 1½ in. and 1½ in. to 2½ in. It was pointed out that this sizing would not be likely to work a hardship on the industry since most producers crush stone to approximately these sizes anyway. The last highway requirement was the abandonment of hand finishing of the pavement.

In discussing the third requirement, Mr. Goldbeck pointed out that what was being sought was the minimum of voids, and that to attain this end more careful gradation of the stone was being undertaken. He said that unquestionably the best results were obtained when the grading was kept uniform throughout the whole job. Mr. Goldbeck explained the use of the triaxial diagrams for proportioning three sizes of aggregates, and explained how a good practical result may be obtained which will so nearly approach the ideal result that the difference will be negligible. As an example he gave the following proportioning amounts as being about the best practical gradation for highway work:

No. 4 to ½ in.	20%
½ in. to 1¼ in.	30%
1¼ in. to 2 in.	50%

Mr. Goldbeck pointed out that the stone men have gotten contractors opposed to crushed stone as an aggregate because of the poor workability with former unscientific proportioning. He admitted that in arbitrary proportioning, such as using 1:2:5 or 1:3:6, the gravel concrete would probably have a much better workability than the crushed stone concrete. However, he said that such was not the case at all when a correctly graded aggregate was used, since a good gradation gave good workability.

Mr. Goldbeck briefly reviewed the tests made by the National Crushed Stone Association laboratory on concrete from aggregates of crushed stone and of gravel obtained from 12 different locations and showed that in this particular series of tests the crushed stone concrete was the stronger. These tests are described elsewhere in this issue of Rock Products. Mr. Goldbeck added that concrete was now being designed so that as small an amount of cement was possible in crushed stone concrete as in gravel concrete to obtain the same results, whereas without special proportioning more cement was necessary.

In a discussion of the effect stone dust had on concrete, Mr. Goldbeck said that the tests just carried out in the association's laboratory indicated that the presence of dust did very little to decrease the strength. In fact, he said that it was quite possible that any decrease in strength shown might easily be accounted for by the increase in the water-cement ratio, since it was necessary to add more water in the tests to keep the workability the same with the stone dust. He pointed out that many quarries are now washing their stone, but added that the national association was not yet prepared to state whether this was necessary or not.

Mr. Goldbeck concluded his talk with a discussion of the necessity of paying attention to the use to which the concrete is to be put when it is designed. As an example, he mentioned the use of concrete where the quality of fire-resistance was important. He pointed out that tests have shown that concrete whose aggregates are of a siliceous nature are not nearly as desirable for fire-resistance as concrete of aggregates which are not siliceous. Siliceous material, such as found in certain types of gravel, will expand under heat and cause spalling, Mr. Goldbeck stated. On the other hand, a good limestone aggregate such as is common in the St. Louis district is not likely to expand, he said, and is therefore suitable for a fire-resisting concrete.

Open Discussion

In the discussion which followed, Mr. Krause asked Mr. Goldbeck what the association's opinion of the comparative merits of the cross bending and percentage of wear tests for concrete roads was. Mr. Goldbeck replied that undoubtedly the cross bending test was the more importance, since roads generally fail through cracking but do not wear thin enough to make any appreciable difference. He added that at present some highway departments are preparing beams of the same concrete as used in the road and curing the beams under identical conditions, so that they can be tested for cross bending strength at stated periods to determine if the road has cured sufficiently to be opened to traffic. This method does away with the arbitrary fixing of a curing period which is usual for concrete roads. The life of a road is not controlled by the wear but by tensile strength of the concrete, since the two greatest factors in destroying a highway, temperature changes and traffic loads, affect the tensile strength only.

W. W. Horner, city engineer, St. Louis, Mo., asked concerning the failure of concrete because of individual pieces of the aggregate wearing out. Mr. Goldbeck said it was entirely possible for some of the pieces of aggregate to disintegrate and break out of the pavement, but that this was not likely to affect the strength of the concrete materially. A lighter weight aggregate, such as slag, is likely to do this, although limestone may also disintegrate in this fashion. However, in examples of such action which he had observed, Mr. Goldbeck said that the hole left where the aggregate disintegrated did not spread and the result was not serious.

The question of segregation was raised, and Mr. Goldbeck suggested a number of methods by which segregation could be avoided. It was possible, he said, to hang a

cross of railroad rails beneath the chute at the plant when a car was being loaded and this would spread the discharge so that it would prevent pyramiding in the car and consequent segregation. Other methods of loading and unloading were discussed. Mr. Goldbeck added that it was the duty of the producer to see that the stone was mechanically mixed as thoroughly as possible before it left the plant.

Registration

Big Bend Quarry Co., St. Louis, Mo.
Mr. Doran.
Mr. Senne.

Bussen Quarries, Inc., Jefferson Barracks, Mo.
Mr. Bussen.
Mr. Bussen.

Columbia Quarry Co., St. Louis, Mo.
E. J. Krause.
Dr. Krause.
Mr. Kiefer.

Eyerman Construction Co., St. Louis, Mo.
Wm. Eyerman, president, St. Louis Quarrymen's Assn.
Mr. Schmolz.

Fehlig Quarry Co., St. Louis, Mo.
E. Fehlig.
T. Fehlig.

Illinois Electric Limestone Co., St. Louis, Mo.
Mr. Moore.
Mr. Murphy.
Mr. Tigges.

Mutual Quarry Co.
Mr. Boggs.
Mr. Kuehl.

Rock Hill Quarries Co., St. Louis, Mo.
Mr. McCullough.
Mr. Henske.

Steffen Bros. Quarry Co., Nursery, Mo.
E. Steffen.
J. Steffen.

Casper Stolle Quarry Co., East St. Louis, Ill.
C. Stolle.
W. Stolle.
Mr. Weber.

Tower Grove Quarry & Construction Co., St. Louis, Mo.
Mr. Olliges.
Mr. Webb.

Union Quarry Co., St. Louis, Mo.
Mr. Schollmeyer.
N. Skrainka.
W. Skrainka.

Wet Batch Co.
Mr. Boone.

National Crushed Stone Association, Washington, D. C.
A. T. Goldbeck, director of bureau of engineering.

St. Louis Quarrymen's Association, St. Louis, Mo.
E. J. McMahon, executive secretary.
W. J. McMahon.

City of St. Louis
Mr. Barnes, Engineering Dept.
Mr. Bowen, Engineer of Bridges.
R. B. Brooks, Director of Streets and Sewers.
Mr. Brown, Engineering Dept.
Mr. Chase, Assistant City Engineer.
Mr. Gundlach, City Engineer's Office.
W. W. Horner, City Engineer.
Mr. Shiffren, Assistant Engineer.

City of Clayton, Mo.
Mr. Steele, Engineering Dept.

City of Maplewood, Mo.
Mr. Mueller, City Engineer.

City of Richmond Heights, Mo.
Mr. Beard, Engineer.

City of University City, Mo.
Mr. Heimbuecher, City Engineer.

City of Webster Groves, Mo.
Mr. Clayton, City Engineer.

St. Louis County, Mo.
Mr. Dozier, Assistant Engineer.

St. Clair County, Ill.
Mr. McCurdy, Assistant Engineer.
Mr. Thomas, Engineer.

Illinois State Highway Dept.
Mr. Wilson.

Missouri State Highway Dept.
Mr. Rudder, District Engineer.

United States Engineer's Office
Mr. Delcommun.

ROCK PRODUCTS
H. M. Fitch.

Toledo Mill Makes Fine Record

THE TOLEDO PLANT of the Medusa Portland Cement Co., located at Silica, Ohio, near Toledo, recently announced the completion of an entire year's operation without a lost-time accident. As this was the first one year safety record in the Medusa organization, it proved of unusual interest and Superintendent W. J. Worthy and his men received many expressions of commendation.

A full year of safe operation was completed at the Toledo plant at midnight, April 5, and on the following evening at 8 o'clock a celebration in honor of the achievement was held in the quarters of the bag department at the mill. Short addresses were made by E. J. Maguire, secretary and treasurer of the company; W. M. Powell, safety engineer, and W. L. White, Jr., general superintendent. W. E. Lopeman, advertising manager, showed motion pictures of the manufacturing process at the various Medusa mills. Several short boxing bouts of four and six rounds were put on, after which Rev. Paul Stowell gave a stirring address on "The Significance of Safety."

Safety enthusiasm was obviously at a high pitch and predictions freely made that this plant would "cap" the present record by winning the Portland Cement Association safety trophy for 1929. Superintendent Worthy of the Toledo plant was greatly pleased with the appreciation shown his mill organization by the visiting officials and read a telegram of congratulation received during the evening from President J. B. John of the Medusa company. A. J. Little, superintendent of the Bay Bridge plant of the company, was present as an invited guest. Mr. Little cast envious eyes on the Toledo record and left for Bay Bridge with a determination to snatch leadership in Medusa safety work for the latter organization.

Music was furnished by the Sylvania high school orchestra and at the close of the program refreshments were served and a general jollification ensued. An official certificate, issued by Frank H. Smith, president of the Portland Cement Association, certifying to the one year perfect safety record of this mill, was later sent to President J. B. John and will be presented by him to the mill at a later date.

The accident records made by the various departments of the Toledo mill were a strong factor in keeping up the feeling among the workmen that a year's operation without an accident is no impossible feat. The department records, which are unusually good, are given in the table below up to April 5.

Quarry, last accident	October	5, 1926—	914 days
Crushing department, last accident	April	17, 1927—	719 days
Coal grinding department, last accident	May	7, 1925—	1429 days
Raw mill, last accident	September	17, 1926—	932 days
Burning department, last accident	July	14, 1926—	997 days
Finishing mill, last accident	March	14, 1926—	1120 days
Cement storage, last accident	November	14, 1924—	1604 days
Packing and shipping department, last accident	August	16, 1927—	599 days
Power department, last accident	April	5, 1928—	365 days
Shops, last accident	May	18, 1926—	1054 days
Railroad, last accident	December	17, 1924—	1571 days
Yard, last accident	September	15, 1926—	934 days

New Crushing Plant Completed by Bussen Quarries, Inc.

BUSSEN QUARRIES, INC., of Jefferson Barracks, Mo., has just completed one of the newest and most modern stone crushing plants in the St. Louis territory. While the new plant is not particularly large, having a daily capacity of only 500 tons, it is thoroughly up-to-date throughout. The plant is on a site which has been worked continuously since 1881, and the operation is now in control of the five Bussen brothers, who are well known in the St. Louis district for their activity in the crushed stone industry.

The new plant is equipped with a Farrel jaw crusher for the primary crushing and a Symons cone crusher for reduction. A Stephens-Adamson rotary sizing screen equipped with three jackets is used for separation and this is followed by a Stephens-Adamson shaker screen. The conveyors throughout the plant are also of Stephens-Adamson manufacture. It is expected that a ring hammer crusher may be installed in the plant at a later period.

The company now operates a quarry with a 45-ft. face. The stone is claimed to be without any flint, and is used both for highway work and for agricultural limestone. It is proposed to change this quarry to a mining operation, as the plant is so situated that blasting in the open is not advisable. The plant is so situated that shipping is possible by rail, truck or barge, as the operation is adjacent to both the Missouri Pacific railroad and the Mississippi river. The company operates two trucks at present, but will have more as soon as business in the new plant requires it.

Ohio River Towboat Burned

THE towboat *Billy Koch,* belonging to the Koch Sand and Gravel Co., Evansville, Ind., while tied up at the company's dock on April 2 was destroyed by fire which is said to have originated in the boiler room of the boat. The loss is estimated at $20,000 and was fully covered by insurance. The boat, which was one of the fastest towboats on the Ohio river, was used to tow sand for the Koch company.

News of All the Industry

Incorporations

Frontenac Quarries, Ltd., St. Sebastien, Que., Canada; $180,000.

Morris Bros., Ltd., Sarnia, Ont., Canada; $50,000. Quarrying.

Marquette Cement Manufacturing Co., La Salle, Ill., has increased directors from seven to nine.

Structural Concrete Unit Corp., Wilmington, Del.; $1,000,000. Concrete blocks.

R. H. and W. E. Bowly, Port Jervis, N. Y.; 100 shares common. Sand and gravel.

Grant Gravel Co., Inc., Pollock, La., has increased capital stock from $8,000 to $15,000.

Pennimen Gravel and Material Co., Dallas, Tex., has increased capital stock from $30,000 to $40,000.

Keystone Builders and Supply Co., Beaver, Penn.; $100,000.

New Scotland Quarries, Delmar, N. Y.; $10,000. E. B. Sanford, Albany.

Eastern Rock Products, Utica, N. Y.; $300,000 preferred, 15,000 shares common. Stone and gravel.

Southern Feldspar Co., Bakersville, N. C.; $50,000. J. A. Dennis and P. B. Bullard, Keene, N. H.; Charles E. Green, Bakersville, and others.

United States Building Products Corp., Wilmington, Del.; $1,000,000. New and second-hand building materials.

Simpson County Gravel Co., Saratoga, Miss., has changed name to Southern Sand and Gravel Co. and increased capital stock to $30,000.

Progressive Cement Products Co., Paterson, N. J.; $50,000. Mary Kay, William G. Kay and Marion S. Kay, Paterson.

West Virginia Lime and Stone Corp., Wilmington, Del.; $2,000,000. James M. Phelan, A. Lauria and Elmer Armstrong, New York, N. Y.

Hudson Block and Supply Co., Union City, N. J.; $50,000. Betty Lerner, West New York; Mervin Herzfeld and Lilian Baum, Union City. Concrete products.

Big Harpeth Quarries, Inc., Newsom Station, Tenn.; $100,000. Ralph E. McClean, Morris E. McClean, George G. Keith, Herbert Fox and J. G. Stephenson.

Snowhite Limestone Co., Pueblo, Colo.; 50,000 shares, no par value. Jay D. Thomas of the Pueblo Lime Co., Pueblo, Colo.; Todd C. Storer, Pueblo, and E. E. Thomas, Garfield, Colo.

Dufferin Paving and Crushed Stone, Ltd., Hagersville, Ont., Canada; 20,000 shares of 7% stock, par $100; 12,000 shares 6%, non-cumulative convertible, par $100, and 70,000 shares common, no par.

Connecticut River Stone Products Corp., Middletown, Conn.; $100,000; 2000 shares, par $50, paid-in capital $10,000. Arthur W. Berresford, Edward P. Decker, New York; George L. Baldwin, Providence, R. I., and Albert P. Hubbell, Darien, Conn. Brick, stone, clay, lumber and cement.

Sand and Gravel

Angeles Gravel and Supply Co., Port Angeles, Wash., has begun the construction of a one-story brick office building on a site adjoining its present quarters.

Iowa Sand and Gravel Corp., Eddyville, Iowa, has been dissolved by the unanimous consent of all the stockholders. H. D. Bellamy was president; T. E. Rust, vice-president, and C. E. Oldham, secretary-treasurer.

Denton Sand and Gravel Co., Pacific, Mo., has completed extensive improvements at its plant, including the installation of some new machinery, and has started a double shift at the plant to meet spring demands. The company expects to be shipping 50 cars a day soon.

Northeast Missouri Sand and Gravel Co., Hannibal, Mo., has been employing a large number of men at its plant near Salt river, preparing for spring operation. Recent high water did considerable damage at the plant and this is being repaired now.

Becker County Sand and Gravel Co., Brainerd, Minn., has purchased the plant of the Detroit Gravel Co. of Detroit Lakes, Minn. The company expects to operate the new pit as well as its old pit when the demand is sufficient. E. A. Mullin is vice-president and general manager of the company.

Wisconsin Wilcox Gravel Co., operating a large plant six miles northeast of Clinton, Wis., and another plant in Janesville, Wis., has announced that it will not operate the Clinton plant this year. Between 45 and 60 carloads of gravel were turned out of the Clinton plant daily. Equipment is valued at about $250,000. Harry Brown has been manager of the plant since it was established.

Missouri Sand and Gravel Co., Louisiana, Mo., is planning a new gravel washing plant on the Salt river, north of Louisiana, according to a report in the *Quincy* (Ill.) *Herald*. This plant will have a capacity three times as large as the company's present plant at Louisiana. About 2000 ft. of railroad track will have to be laid to connect with the new plant. It is reported that John Fierke, an engineer formerly connected with the Missouri State Highway Department, will be superintendent at the plant.

John N. Bos Sand Co., Chicago, has started the construction of a modern building material and coal yard in Elmwood Park, a suburb of Chicago. A two-story office building, a warehouse and a garage will be completed within 60 days. A railroad track 1800 ft. long is being constructed to the new yard, and this will serve for unloading 25 cars at one time. This is the first combined wholesale and retail yard of the company, as previous yards have been for wholesale distribution only. The cost will be approximately $150,000.

Quarries

Massman Construction Co., Carrollton, Mo., is opening a stone quarry on the Henry Loutenschlager farm near Miami Station. The stone quarried there will be used in Missouri river improvement projects, the contracts for which this firm has.

C. S. Cary, Sparta, Ga., has purchased the Johnson tract of land, about seven miles from Sparta, containing about 50 acres of granite. Much of the stone is above the ground and the vein of rock is said to run deep below the surface. He expects to erect a large crusher and ship crushed stone for road-building purposes.

Cement

Manitowoc Portland Cement Co., Manitowoc, Wis., has been awarded a contract by the Wisconsin State Highway Commission to furnish 146,000 bbl. of cement out of a total of 230,000 bbl. to be used on Wisconsin roads this summer. This contract, together with the other orders which the company has on hand, is expected to keep the company's plant operating at capacity all summer.

Monolith Portland Cement Co., Los Angeles, Calif., has sent Capt. A. Bullock Webster to Japan to establish trade connections for the company. According to the *Los Angeles Examiner*, it is supposed that the Monolith company is making a concentrated effort to develop a substantial market in the Orient. Capt. Webster has been connected with the company as resident sales representative in Honolulu.

Alpha Portland Cement Co., Easton, Penn., gave a banquet on April 9th for the employes of its Birmingham, Ala., plant in recognition of the safety record achieved by the plant during the past months. This banquet is a quarterly affair and was under the direction of H. O. Underhill, superintendent of the plant. E. C. Phillips, safety director, acted as toastmaster, and a fine program followed the dinner.

Atlas Portland Cement Co. of Texas, Waco, Texas, is expected to start operating its new plant at Waco within the next two months. Six mechanics from the Atlas plant at Independence, Kan., are at present at Waco assisting with the installation of machinery at the new plant. Charles H. Dickens, assistant chief chemist for the Atlas Portland Cement Co. of Kansas, for the past eight years, has been promoted to chief chemist of the Atlas Portland Cement Co. of Texas, and left with his family for Waco, to take up his new duties. His work at Waco began on April 1.

Idaho Portland Cement Co., Pocatella, Idaho, is rapidly completing its plant at Inkom, and expects to have it in operation by the latter part of May. A directors' meeting was held in Pocatello on April 9th at which the following officers were elected: E. J. Simons, president; J. B. Maxfield, first vice-president; J. H. Neill, second vice-president and consulting engineer; J. Tom O'Brien, treasurer; A. J. Lindsay, secretary. These men with Eugene Enloe and N. J. Dolph of Spokane comprise the board of directors of the company. Mr. Neill is also treasurer and general superintendent of the International Portland Cement Co. of Spokane, Wash. The directors gave the management a vote of confidence for the good work accomplished in bringing the plant to completion in such a short time.

Cement Products

Bluffton Cement Block Co., Bluffton, Ohio, has been sold to Lloyd Murray and Henry Balmer. The new owners expect to make some changes and improvements.

Concrete Mixing Co., St. Joseph, Mo., has completed improvements at its central mixing plant totaling $80,000. These include a new mixer with a capacity of 600 yd. per day, a large crane and some new trucks.

Concrete Products Co., Anderson, Ind., is being organized and is now equipping a plant for the production of Haydite products. J. W. Bailey Co. is installing machinery for the plant.

Ready Mixed Concrete Co., Mobile, Ala., has been organized and is planning to start a plant for the production of centrally-mixed concrete soon. The site has already been selected at the foot of Palmetto St., and the company will have a yard there which will have a capacity of 300 cu. yd. daily.

Lime

Penn Lime, Stone and Cement Co., which was formerly located at Lancaster, Penn., has moved its main office to Rheems, Penn.

Standard Products, Inc., Medford, Ore., with a capitalization of $60,000, has been organized by J. H. Weber, president and manager; T. H. Callaghan, vice-president and treasurer, and M. T. MacNeff, secretary. The company has leased the old Cameron limestone quarry at Applegate, Ore., and will begin immediate construction of a plant to manufacture commercial lime, fertilizer and sand-lime brick. The products of the company will be labeled with the "Crater Lake" brand.

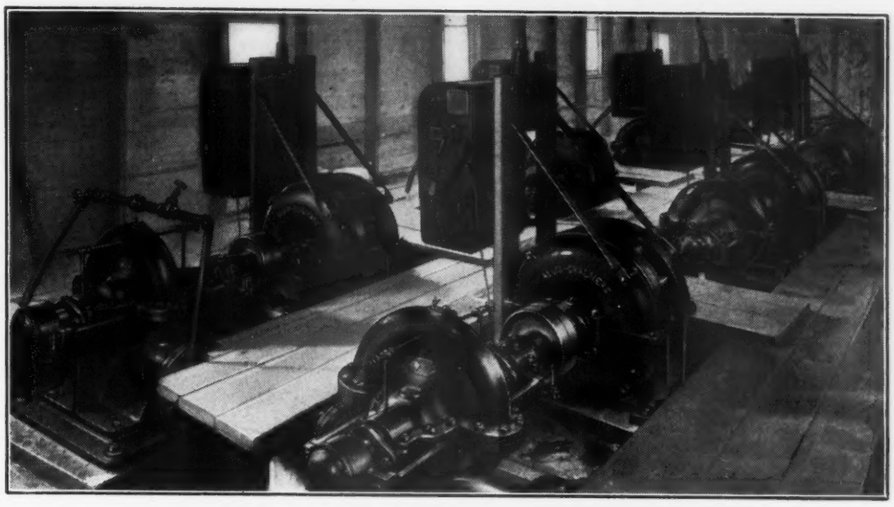
Gypsum

United States Gypsum Co., Chicago, Ill., will take over a new 6400-ton vessel of special design, now under construction in a British ship yards, for use in transporting gypsum from Nova Scotia to the company's Atlantic seaboard plants. The steamer has been constructed especially for the most economical transport of gypsum rock. It will be operated by the Gypsum Packet Co., a subsidiary of the main company.

Phosphate Rock

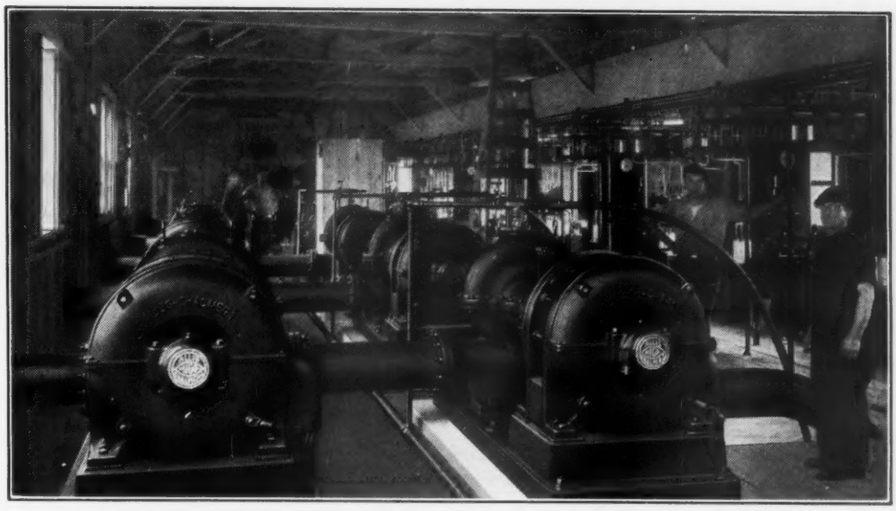
Hoover Co., Chicago, Ill., has announced the removal of its Chicago offices from the Railway Exchange to the Willoughby Tower. With the main company's transfer, the affiliated companies also move to the Willoughby Tower. These include the Hoover and Mason Phosphate Co., the Ruhm Phosphate and Chemical Co., Hoover and Mason, Frank K. Hoover, Ray P. Hoover, and H. Earl Hoover.

CENTRIFUGAL PUMPING UNITS
WHICH WILL HELP OUT IN THE HARD PLACES



6-8" types pumps with 125 h.p. motors sluicing earth for Toronto Reservoir Dam. Fred T. Ley & Co., Inc., Contractors.

Any process or undertaking requiring the use of centrifugal pumps can be materially helped or hindered by the kind of pumps and their proper application. Allis-Chalmers centrifugal pumps with Allis-Chalmers motors are the kind of units that help, and our representatives can assist you in their proper application. On two recent construction jobs contractors had to build large earth-filled dams, and Allis-Chalmers Centrifugal Pumping Units were selected for hydraulic sluicing service. The high reliability factor of our units was of great assistance in the satisfactory completion of the work and the contractors were highly pleased with the performance of the Allis-Chalmers Centrifugal Pumping Units of combined responsibility.



6-10" types pumps with 200 h.p. motors sluicing earth for dam for Northern N. Y. Utilities Inc. U. G. I. Co., contractors.

ALLIS-CHALMERS
MILWAUKEE, WIS. U. S. A.

Obituaries

Charles E. Carpenter, president of E. F. Houghton & Co., North Philadelphia, Penn., died on Saturday, April 6, at Miami Beach, Fla. Mr. Carpenter was well known as the editor of *The Houghton Line.* He was 67 years old.

James McPherson, a quarrying expert of Denver, Colo., dropped dead from heart disease just after he had completed the inspection of a quarry in Unaweep canyon on March 29th. He was about 65 years old.

Charles L. Armstrong, former manager of the British Columbia Gypsum Co., died at Vancouver, B. C., recently. He had been manager of the gypsum company for five years but retired last fall because of ill health. He was 56 years old.

Personals

Theodore Dickinson, president of the Marquette Cement Manufacturing Co., of Chicago, has been named a member of the board of regents of the University of Miami at Miami, Fla.

Fritz Worm, who has been assistant superintendent of the cement plants of the Cowham System, has been transferred to the Alabama-Quenelda Graphite Co. to take charge of that company's plants in the vicinity of Birmingham.

H. A. Baker of Schenectady, N. Y., has been appointed as service manager of the International General Electric Co., with headquarters in New York City. Mr. Baker succeeds C. F. Neave, who has been named manager of the newly organized refrigeration department of the company.

Sewell L. Avery, president of the United States Gypsum Co., Chicago, has been made one of the directors of a new $60,000,000 finance corporation, known as the Chicago Corporation. This is the largest company of its kind in the middle west, according to newspaper reports.

W. H. Muirhead, vice-president and manager of the Beaver Portland Cement Co., Gold Hill, Ore., has been designated by the Grants Pass and Gold Hill Chamber of Commerce as representative to appear before the mining committee of the state legislature to work for a mining survey of the state.

George H. Houston, formerly a director of the Baldwin Locomotive Works, Philadelphia, Penn., was elected president at the organization meeting of directors recently, succeeding Samuel W. Vauclain, who was elected chairman of the board. Thomas S. Gates was elected chairman of the executive committee.

R. A. Shilbauer, formerly assistant advertising manager of the Chain Belt Co., Milwaukee, Wis., is now advertising manager. He joined the company as a rate-setter in 1920 and worked in that capacity in the various departments of the company's Grey Iron Foundry and assembly plants. In 1925 he was placed in the advertising department, where he later became assistant advertising manager. Mr. Shilbauer succeeded A. R. Abelt, who will devote his entire time to his position as sales manager of the chain and transmission division of the company.

Charles E. Ashcraft is now handling the sale of Sauerman equipment in western Pennsylvania and the adjoining border counties in Ohio and West Virginia. He is a native of Kentucky and a graduate in Civil Engineering from the University of Cincinnati. Considerable experience in the engineering and construction field with such companies as the Foundation Co., Baker-Dunbar-Allen Co., the Army Engineers, and during the past eight years as engineer and salesman for the Beckwith Machinery Co., Pittsburgh, forms the background of his business career and makes him admirably fitted to act not only in a sales capacity but also in an advisory one for Sauerman customers. Mr. Ashcraft's headquarters are at 335 Fifth Ave., Pittsburgh, Penn.

Manufacturers

Industrial Brownhoist Corp., Cleveland, Ohio, has moved its Pittsburgh offices from the Oliver Bldg. into the new Koppers Bldg. L. Kleinhans continues in charge of this office in its new location.

Barber-Greene Co., Aurora, Ill., announce that their complete line will be handled by Wm. H. Ziegler Co., of Minneapolis, Minn., at their new branch at Fargo, N. D. The Fargo office of the Ziegler company will be in charge of O. H. Strand.

Robbins & Myers, Inc., Springfield, Ohio, is adding to its line of electric motors, motor-generator sets and electric fans, a complete new line of improved electric and hand-power cranes, hoists and trolleys up to 10 tons capacity. Frank S. Seaman has been appointed general manager of the new crane and hoist division. Carl E. Schirmer is chief engineer. Sales are in charge of John R. Mears, and Albert Kreh, Wm. J. Scott and John J. Becker are district sales managers for New York, Chicago and Detroit respectively.

Northern Blower Co., Cleveland, Ohio, is extending its plant at West 65th St. and Barberton Ave. by the addition of manufacturing floor space of 75x125 ft. The old building occupying this space has been torn down and the building which is replacing it will be of the most modern construction. The company, which for a number of years has specialized in dust collecting equipment, has grown from small beginnings. In 1911 it was started in a barn on Storer Ave., Cleveland, and has since been repeatedly extended until at the present time it is housed in what will be when completed one of the best equipped plants of its kind.

A. P. Green Fire Brick Co., Mexico, Mo., has recently announced several additions to its distributing organization: James H. Richards Fire Brick Co., 1137 Schofield Bldg., Cleveland, Ohio, who has been handling A. P. Green firebrick in the Cleveland district for some time, has also been appointed as distributor for A. P. Green fire-brick accessory products, "Sairset" air-setting high temperature bonding mortar and "Quik-Pach" plastic fire brick. In the Toledo district the Steam-Economies-Toledo Co., 3357 Blanchard St., Toledo, Ohio, has been appointed distributor for the two last mentioned products. W. H. Bixby Co., 524 First National Bank Bldg., Omaha, Neb., are distributors for A. P. Green products in Nebraska and the western part of Iowa.

Fort Pitt Steel Casting Co., McKeesport, Penn., announces that Wm. J. Corbett, who resigned as secretary-manager of the Steel Founders' Society of America, has become associated with their company as assistant to the president Mr. Corbett, who is a prominent steel foundryman, was graduated from Carnegie Institute of Technology in 1914. After considerable experience in various capacities with some of the big steel foundries, in 1923 he became industrial engineer for the Electric Steel Founders' Research Group, composed of five leading electric steel foundries, organized to conduct co-operative research work on the manufacture of steel castings. The Fort Pitt Steel Casting Co. is a member of this group. He resigned this position in 1925 to become secretary-manager of the Steel Founders' Society of America, which position he held until he became associated with the Fort Pitt company.

Trade Literature

NOTICE—Any publication mentioned under this heading will be sent free unless otherwise noted, to readers, on request to the firm issuing the publication. When writing for any of the items kindly mention ROCK PRODUCTS.

Engineering and Contracting. Booklet recording some of the experiences of five prominent executives in this field over a period of 25 years, and issued in celebration of the 25th anniversary of the ROBERTS AND SCHAEFER CO., Wrigley Bldg., Chicago, Ill.

Compressors. Bulletin **No. L-620-B1** on Worthington vertical "Feather-Valve" compressors, exceptionally well illustrated and giving sizes, ratings, construction and application details. WORTHINGTON PUMP AND MACHINERY CORP., 2 Park Ave., New York City.

Calcium Chloride. Reprint of an article by "Spec" Collins, entitled "Concrete Products vs. Cold Weather," giving observations on the use of calcium chloride as an accelerator in the manufacture of concrete products during the winter months. SOLVAY SALES CORP., 40 Rector St., New York City.

Diesel Engines. Bulletin **No. 774,** covering M. W. M. Benz Diesel Engines, Type RH40, in horsepower from 80 to 240 at 327 r.p.m., and containing chart showing comparison of cost of fuel for oil, gas and steam engines and current for electric motors. CHICAGO PNEUMATIC TOOL CO., 6 East 44th St., New York City.

Transformers and Single Phase Motors New 52-page catalog, designated as Bulletin **No. 160,** describing complete line of distribution transformers in single-phase and three-phase, pole-type and subway-type, in ratings up to and including 500 kv.-a. and giving construction details, shipping weights, etc. Also illustrated Bulletin **No. 157** on single-phase repulsion induction motors, covering such subjects as types of single-phase motors, history of repulsion induction motors, operating principles (both electrical and mechanical), construction features, etc. WAGNER ELECTRIC CORP., St. Louis, Mo.

Universal Gypsum and Lime Co. in Receivers Hands

EUGENE HOLLAND, president of the Universal Gypsum and Lime Co., Chicago, Ill., and Abel Davis were appointed receivers April 22 for the Universal company, a corporation with assets of more than $7,500,000. The appointments were made by Judge James H. Wilkerson in the United States district court at Chicago.

The receivership proceedings were instituted by the International Cooperage Co. An intervening petition filed by Attorneys Henry K. Urion and Henry W. Drucker in behalf of the State Bank of Chicago alleged default in the payment of interest and sinking fund provisions on the $1,754,000 of 6% first mortgage bonds of the gypsum company, due March 1.

A letter which has been sent to the stockholders' protective committee sets forth that "It has been determined that an immediate operating receivership is advisable in order to avoid closing the plants of the company which, in the present condition of the industry, would come at an unfavorable time." —*Chicago Journal of Commerce.*

Building Industry to Be Discussed at National Chamber of Commerce Meeting

FROM a conglomeration of small, isolated plants, industry in the United States has become, to a large degree, an organic whole. A dislocation or change in one section often affects all others.

If your city is building industries, how will they be affected by such conditions? Can you answer these questions:

What factors common to most industries should be considered in an appraisal of the extent of the economic location of manufacturing plants?

What proportion of all plants built prior to 1920 may be considered to be (1) uneconomically located to meet present day competition, and (2) obsolete in commodities, plant, equipment or management?

Taking into account (1) uneconomic location and (2) obsolescence, is there a general excess of plant capacity?

Can obsolescent plants be modernized, or are most such plants on their way to the scrap heap?

Is it practicable to organize the manufacturers of a locality for the purpose of continuous study of methods for keeping up-to-date on plant operation and management?

As an aid to sound industrial extension what can the trade association do?

What can the chamber of commerce do?

Answers will be forthcoming at a round table session of the 17th annual meeting of the national chamber of commerce, Washington, D. C., April 29-May 3.